SUDAN'S HIDDEN TEMPLES | TRAVELS OF THE FLIGHTLESS BIRDS

ROTUNDA

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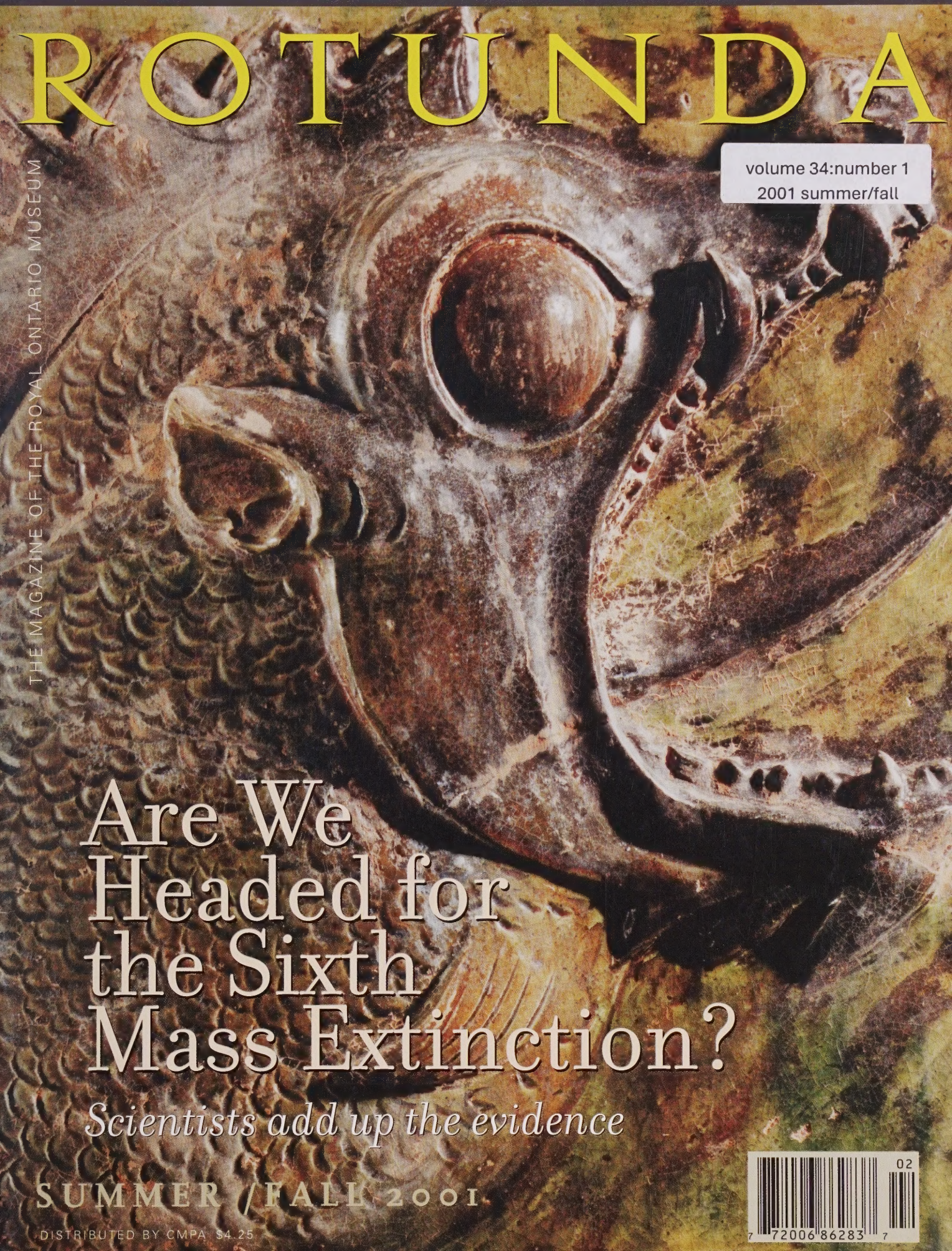

Are We Headed for the Sixth Mass Extinction?

Scientists add up the evidence

SUMMER / FALL 2001

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J. W. Morrice, Children at Play, Antwerp 1906, 31" x 25" oil, private collection, Calgary

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COMING FALL 2001

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COVER IMAGE: CHINESE TILE, 6TH CENTURY AD, FROM THE JOEY AND TOBY TANENBAUM GIFT. PHOTO: ARIADNE GALLERIES, INC.

Oliver Haddrath

Centre for Biodiversity and Conservation Biology

OLIVER (*Grounded Wanderers*) has been a technician in the Centre for 12 years and is responsible for operations in one of the ROM's two molecular genetic research labs. Recently, Oliver (left) completed his Master's thesis on the large flightless birds (ratites) and their diversification across the southern hemisphere as it has been shaped by continental drift. Results from this groundbreaking study—one of the first to include complete mitochondrial genomes from extinct species—were published recently in *Proceedings of the Royal Society of London*.

Dr. Allan J. Baker

Centre for Biodiversity and Conservation Biology

ALLAN (*Grounded Wanderers*) is head of the ROM's Centre for Biodiversity and Conservation Biology. A native of New Zealand, he arrived at the ROM to take the position of assistant curator, Ornithology, 29 years ago. His keen interest in shorebirds, developed at an early age, has led to a life-long quest to elucidate their evolutionary relationships. Through his research program at the ROM and his teaching work as a professor of Zoology at University of Toronto, Allan has become established as one of the world's leading authorities on avian population structure, speciation, molecular evolution, and systematics.

SLAWOMIR GRZYMSKI

Dr. Julie R. Anderson

Department of Near Eastern and Asian Civilizations

JULIE (*Sudan: Land of the Hidden Temples*) is a research associate at the ROM, and has excavated in Nubia for the last 14 years. Since 1997, she has been co-director of the Canadian-Sudanese Berber-Abidiya Archaeological Project.

Dr. Krzysztof Grzymski

Department of Near Eastern and Asian Civilizations

KRZYSZTOF (*Sudan: Land of the Hidden Temples*) is senior curator of Egyptology at the ROM and has excavated in Nubia since the early 1980s. He was the key scholar in developing the ROM's Nubian Gallery.

William M. Glenn

Freelance Writer

WILLIAM (*Eve of Extinction*) is an award-winning author of more than 20 books on environmental issues. He writes widely on the threats posed by toxic chemicals and other hazards of the modern age. "When I'm up to my figurative neck in PCBs and CFCs," he says, "I can really get nostalgic about my undergrad days rooting around in the ROM's ornithology collection. It's been nice to come back for a visit."

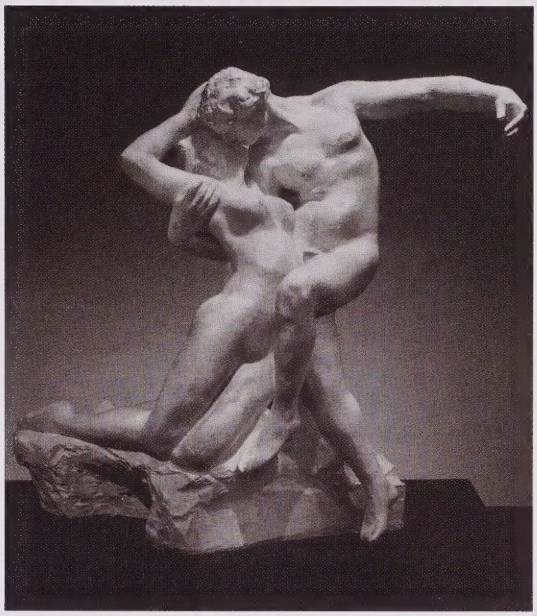
WILLIAM THORSELL

FOR MOST PEOPLE, June 30 marks the halfway point of the year and the beginning of summer holidays. Here at the ROM, June 30 represents the end of one fiscal year and the beginning of another. The past 12 months have witnessed an amazing breadth of work and activity at the Museum. We now look to the upcoming year with a surfeit of projects and good ideas as we embark on our ambitious Master Plan for Renaissance ROM.

Our first major public steps in realizing our Master Plan vision took place at the end of June, when advertisements appeared in *The New York Times* and *The Globe and Mail* seeking expressions of interest from architectural firms around the world. Twelve firms will be selected and will be provided with additional background materials and sketchbooks. The 12 sketchbooks will be displayed for public comment in October, then three finalists will be asked to produce more detailed drawings and a model for public presentation in January.

However, while planning for the future, the show must continue to go on. The coming year brings a rich menu of programs sure to appeal to a variety of people young and old. In September, we open *From Plaster to Bronze: The Sculpture of Auguste Rodin*, a blockbuster exhibit of 70 Rodin works organized by the MacLaren Art Centre in Barrie. This show will be one of the most significant exhibitions of Rodin's art in recent memory, and will include many plaster sculptures that have never before been on public exhibition.

In October, *Papiers à la Mode: Illusions of Fashion by Isabelle de Borchgrave and Rita Brown*, a beautiful exhibition of paper dresses debuts at the ROM's Institute of Contemporary Culture.



Eternal Spring is one of 70 sculptures by Auguste Rodin that will be exhibited at the ROM this fall.

Collection of the MacLaren Art Centre, Barrie, Ontario

Also in October, we launch *More than Keeping Cool: Chinese Fans and Fan Paintings* in the Levy Gallery, a special exhibit of Chinese fans drawn from the vast collections of the ROM.

In December, the highly anticipated exhibit *Great Asian Dinosaurs! Unique Creatures From Russia's Vaults* will open. More than 60 skeletons, skulls, and fossil eggs of Asian dinosaurs and other prehistoric animals, supplemented by specimens from the ROM's collection, will be on display. It will run from Boxing Day through the end of March 2002, providing ample opportunity for family visits during the holidays and through to March Break.

Our desire to showcase more First Nations culture and history is represented on the exhibition schedule by two shows. The first, *Mohawk Ideals, Victorian Values: The Legacy of Oronhyatekha*, opening in March 2002, introduces the public to Dr. Oronhyatekha, a Mohawk physician and businessman who lived from 1841–1907. Dr. Oronhyatekha made an indelible mark on Canadian history, helping to shape the relations of First Nations with Canada. Our second First Nations exhibit, *Across Borders: Beadwork of Iroquois Life*, will open in June, and explores the significance of beads in Iroquoian culture and the important role beadwork played in the survival of the Iroquois.

Our programming plans for the coming year will reflect the variety of this exhibition calendar. We intend to build on the enormous success of ROM Friday Nights by offering additional programming, including Sixteen Sundays, family-oriented programs offered on Sunday afternoons beginning in January 2001; ROM Wednesdays intended especially for seniors; enhanced holiday and March Break programming; and a major expansion of programming activities around the Institute of Contemporary Culture.

Finally, I'd like to introduce you to a name you are likely already familiar with. As president and chief executive officer of Brascan Corporation, Jack Cockwell is a well-known business leader with a reputation as an effective team player. As of July 1, Jack became chair of the ROM's Board of Trustees, succeeding outgoing chair Steve Lowden. For the past four years, Steve led the ROM through a period of significant growth, change, and restructuring. Though stepping down as chair, Steve will continue to serve on the Board.

Our goal of enriching the whole Museum experience through Renaissance ROM will take several years, but, at the end of the project, our goal is to make the ROM a "must-see" destination for tourists and local residents alike. Using our current exhibit and programming schedule as an indicator, we are off to a fine start.

BRIAN BOYLE, ROM / 2001.24.1

Reading Between the Roses

Out-of-this-World Wishes in Chinese Scroll

In 1637, Chinese artist Wang Weilie painted this scroll, recently acquired by the ROM with the generous support of the Louise Hawley Stone Charitable Trust. A pair of paradise flycatchers preen themselves on a jagged rock, surrounded by narcissi, roses, and prunus. Exuberant life permeates the scene—even the perforated rocks seem to come alive. The scroll would have made an ideal birthday gift: the rock, paradise flycatcher, and prunus are symbols of longevity. What's more, all three flowers and the birds combine to form a visual pun meaning, "the immortals wishing you many happy returns."

—Ka Bo Tsang

ED KEALL, ROM

Rock Art Mystery in Yemen

Were Ancient Finger Paintings Made by Hunters?

Last March, under the direction of Ed Keall, ROM archaeologists conducted their first scientific study of rock art in Yemen. In the foothills of the Yemeni Highlands, on the face of a rock-shelter called al-Mastur, the team recorded ancient figures of humans and animals, schematic devices, and symbols sketched out in red paint. All the images likely date to the same time period. Admittedly, though, the team faces the same dilemma as others who study rock art around the world: it is notoriously difficult to interpret and date, particularly where, as in Yemen, the cultural record has been little examined.

The human forms—literally stick figures—are depicted with no head. One drawing suggests a person inside a corral. Another shows a bow-legged stick figure with upper limbs that split in two, and a noticeable protuberance between the legs. Some see this as a penis, but it's also possible that the figure represents a skinned pelt, as suggested by the ROM's Jean Charing. This idea is by no means implausible since the rock shelter was most likely used as a hunting look-out. Some of the schematic devices have been interpreted as hunting traps, which adds to the connotation.

Beneath the paintings, the crew unearthed stone tools of a type attributable to the paleolithic tradition. The tools imply a date before 8000 BC—improbably early for the paintings. Despite the time discrepancy, though, the only logical interpretation is to connect the tools and paintings to the same culture. As was often the case, technological change might not have occurred in ancient Yemen at the same time as it did elsewhere. If hunters found archaic tools efficient, and the paintings are older than the 2500 BC that was first believed, say 6000–4000 BC, then we can more readily link the two.

—Ed Keall

BRIAN BOYLE, ROM / 920.67.10

Shields of Dreams

Mughal dhals *sport "designer label" rhino*

THE SHIELD IS likely the oldest form of defensive weapon. In India, it first appeared in the 3rd century AD. Scholars know this from images on Gandhara sculpture of the same date, depicting shields — likely a type made of animal hide, called *dhal*. In ancient India, shields were an important component of ceremonial dress, reflecting the social status of the bearer. Adorned with precious or semi-precious stones, gilded mounts, and sophisticated ornamentation, many *dhals* reflect incredible craftsmanship. They were manufactured in India right into the Mughal period, beginning in the 16th century, and continued practically unchanged until the early 19th century.

The leather for shields was harvested from a great variety of animals that originally inhabited Pakistan, India, Nepal, and Bangladesh—sambar (a type of deer), Asian water buffalo, nilgai or bluebuck, Indian elephant, and Great Indian rhinoceros. Rhinoceros *dhals* were in highest demand. After preparation, rhino hides are translucent, almost transparent. Artists sometimes left a small "window" in their painted ornamentation of rhinoceros *dhals* to demonstrate the hide's clarity, and therefore its high quality and value.

The 17th-century *dhal*, above, is likely of rhino hide and originates from Rajasthan, an area famous for crafting exquisite accoutrements for the Mughal aristocracy.

—Krzysztof Ciuk and Susan M. Woodward

William and Lelia Brayfield

PALAEOBIOLOGY ARCHIVES

BRIAN BOYLE, ROM / ROM 51011

'Gator Aid for Paleontologists

Florida fossil hunters donate Ice-Age collection

COLLECTING FOSSILS has long been a way of life for Lelia and William Brayfield of Port Charlotte, Florida, field associates in the ROM's Department of Palaeobiology. Locally renowned for their knowledge and expertise—they published their own book on identifying Florida's fossil shells—the Brayfields recently donated their lifetime collection of fossil vertebrates to the ROM. Consisting of more than 11,000 catalogued specimens, the collection contains bones of a wide variety of vertebrate animals from the Pliocene and Pleistocene of southwestern Florida—about the last 5 million years of Earth's history. Dominant are bones and teeth of extinct Ice-Age herbivorous mammals, such as horses, camels, and mastodons, but there are also bones of fish, amphibians, birds, and reptiles, such as the almost complete skull of *Alligator mississippiensis* from the Late Pleistocene, pictured above, representing a huge animal about 5 metres (17 feet) in length. Almost exclusively through their own collecting efforts, the Brayfields painstakingly assembled the collection over 30 years, accurately recording field data for each specimen. Their documentation reveals a number of important and previously unknown collecting localities to paleontologists. The Brayfield collection should prove invaluable for future studies on North America's Ice-Age faunas.

—Kevin Seymour

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WRITE TO: *ROTUNDA*, 100 QUEEN'S PARK, TORONTO, ONTARIO M5S 2C6.
THE EDITORS RESERVE THE RIGHT TO EDIT FOR LENGTH AND CLARITY

Native or Not?

REGARDING "Maples—Think Canadian" (Winter 2000), Ms. D. Metsger states there are only six Ontario maples, that "Manitoba maple is not native to Ontario but has migrated here from other regions of Canada." This contradicts J. H. White, *The Forest Trees of Ontario* 1925/1946 (R. C. Hosie), who considered it native.

Manitoba maple (box elder) certainly is common in northwestern Ontario. Perhaps Ms. Metsger, when she says Ontario, means only that 10 percent bit of the province south of the French River.

I would appreciate some clarification as to what "regions" the species came from and when it began to migrate into Ontario.

ALAN MOON
THUNDER BAY, ONTARIO

Deborah Metsger responds: Mr. Moon is correct; the distribution map found in *Trees in Canada*, by John Laird Farrar—a standard reference work published in 1995 by Fitzhenry and Whiteside Limited and the Canadian Forestry Service—does show the natural Canadian range of *Acer negundo* extending across southern Saskatchewan and Manitoba and just into extreme western Ontario.

The Manitoba maple is thus nonnative in more than 90 percent of the province. As a flood-plain species and a highly successful weed, it migrated eastward from the prairie provinces.

It spread by colonization along watercourses and by planting, becoming widespread throughout the mixed and deciduous forest regions of the province after European contact. For instance, in the Humber marshes of Toronto, Manitoba maple first appears in the fossil record in 1875, as McAndrews illustrates in the 1999 book edited by Roots, Chant, and Heidenreich, *Special Places, the Changing Ecosystems of the Toronto Region*.

Earthworms Aside

I enjoyed Don Stacey's article on earthworms in your fall issue (Fall 2000). There is no doubt that earthworms contribute to soil fertility in areas where they are abundant. However, Mr. Stacey failed to point out that crops grow equally well in areas where earthworms are unknown.

I grew up on a farm in central Manitoba. It wasn't until I left the farm, at age 15, and moved to southern Ontario that I saw my first earthworm. Up until that time I was unaware that such creatures actually existed and believed them to be the inventions of comic artists and other cartoonists.

Incidentally, the absence of earthworms in regions of Manitoba is well documented. *Harmsworth Popular Science*, published in London in 1913, specifically mentions the absence of earthworms in certain areas of Manitoba.

R. S. CRAGGS
WEST HILL, ONTARIO

CULTURE, ART AND DESIGN

PORTRAITS OF POWER

A silver coin—one of the two recently donated to the ROM—commemorates the fateful event that most likely precipitated the assassination of Julius Caesar in the Roman Senate.

998.137.1

998.137.2

BRIAN BOYLE, ROM

ALISON EASSON

AT THE HEIGHT OF HIS remarkable career, just before his assassination at age 55, the famed Julius Caesar was commemorated in portraits on two silver denarii, recent gifts to the ROM. Both coins were struck in 44 BC.

By that time, Caesar had already been granted four triumphs by the Roman Senate for his victories over the Gauls, Egypt, the kingdom of Pontus, and Numidia in northern Africa. At home, his troops were winning the civil war against the sons of Pompey the Great. Caesar and his supporters controlled the Senate.

In January of 44 BC, for the fifth time, Caesar was made consul—the chief Roman magistrate—and for the fourth time, given the dictatorship

Top right: Caesar's portrait on this silver coin from 44 BC indicates he had been made dictator for life, an event that may have precipitated his assassination.

Bottom right: The coin's reverse shows Venus, from whom the Julian clan believed themselves to be descended.

Top left: A coin from earlier that year depicts a curved auger, indicating that Caesar was an official diviner.

Bottom left: The reverse of this coin shows Juno the Saviour in a fast chariot. This coin was unevenly struck.

with absolute power. Mere weeks later, sometime between January 20 and February 15, he was again made dictator—this time for life—and designated *parens patriae,* father of the country.

The coins themselves are evidence of Caesar's power—he was the first living Roman permitted to place his own portrait on currency. Traditionally, the Roman Republic allowed the moneyers—those men responsible for issuing coins—to use only portraits of famous ancestors or past heroes.

The first of the ROM's two denarii shows Caesar wearing the *corona aurea*, the golden crown given in honour of a triumph over Rome's enemies, and behind his head is written *CAESAR.DICT.QUART*—meaning Caesar was dictator for the fourth time. This coin must have been struck early in 44 BC, before he received the dictatorship for life. The curved staff of the auger indicates Caesar was an official diviner, trained to observe signs that would indicate whether the gods favoured a proposed action.

On the coin's reverse is a very military Juno Sospita, or Juno the Saviour, in a fast *biga*—a two-horse chariot. She is wearing a goatskin and is armed with a spear and shield. Below this scene, the moneyer's name would normally appear. This coin was unevenly struck, and the name—in this case M. Mettius, known from other coins—was not impressed.

On the second denarius, the words *CAESAR.DICT.PERPETUO* appear behind Caesar's head, again crowned with the *corona aurea.* The words refer to him as dictator in perpetuity, dating the coin to sometime between January 20 and March 15, 44 BC, when he died. On the reverse, Venus—shown as Venus Victrix, or Victorious Venus holding Victory on her hand—is sitting with a sceptre on a low-backed throne. The Julian clan to which Caesar belonged believed they were descended from this goddess. Behind Venus is the name of the moneyer in charge of this issue, L. Buca.

By virtue of his political strength and autocratic control over the Senate, Caesar had made enemies in Rome. Constitutionally, the dictatorship was an emergency measure, meant to last only as long as it was needed. His acceptance of the position for life was unwise. It increased the anger and fear that had been building up, and even his friends began to conspire against him.

The end came on March 15, the Ides of March, when it was widely known that Caesar would be at the Senate—as he only occasionally was—and that he was planning to leave immediately afterwards to fight the Parthians in the East. When he arrived, Caesar was set upon and stabbed to death by a group of conspirators, among them Publius Casca Longus, Gaius Cassius Longinus, and Marcus Brutus. Caesar's mistress, Cleopatra, who was in Rome at the time trying to consolidate her position as queen of Egypt, left hurriedly for Alexandria. Later, she claimed that Caesar was the father of her son, Ptolemy, nicknamed Caesarion.

The ROM's two denarii depicting Caesar were donated by Dr. Sheila Campbell, executor of the estate of the late Dr. Elisabeth Alföldi-Rosenbaum. The coins were acquired by Alföldi-Rosenbaum's husband, the late Andreas Alföldi, a professor at the Institute for Advanced Study in Princeton who specialized in the history of the Roman Republic and wrote extensively about Julius Caesar.

These significant coins fill a gap in the Museum's existing collection of 526 Roman Republican coins. The earliest in the collection date to 260–242 BC, and the latest are denarii issued by Marcus Antonius in 32–31 BC in his fight to control the Roman world after Caesar's death, before his subsequent defeat by Octavian, Caesar's grandnephew.

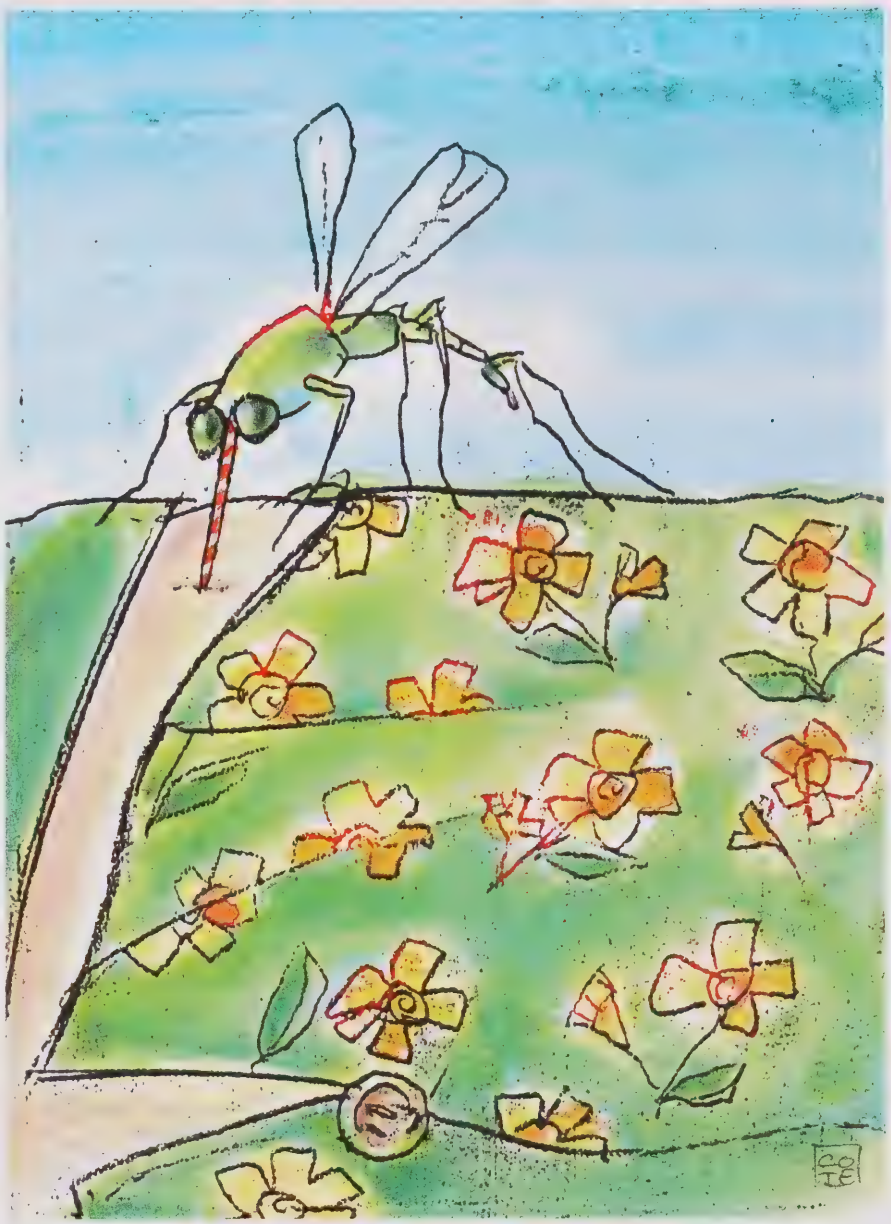
Alison Easson is a ROM curator specializing in the Greek and Roman area and author of the book Roman Republican Coins in the Royal Ontario Museum *(1998, Royal Ontario Museum).*

LIFE ON EARTH

MMMMMMMMOSQUITOES

Everything you wanted to know about this ubiquitous pest. . . and were afraid to ask.

"Hudson's Bay is certainly a country that Sinbad the Sailor never saw, as he makes no mention of mosquitoes."
—David Thompson, geographer, from *Travels in Western North America, 1784–1812* (1971), edited by Victor G. Hopwood.



GENVIÈVE COTE

DOUG CURRIE

MOSQUITOES ARE PERHAPS the most familiar—and loathed—of the organisms that inhabit our backyards. While other biting flies may be severe pests in particular areas of Ontario, mosquitoes are ubiquitous, occurring abundantly in both urban and rural settings. For those who enjoy the outdoors, there is little relief from bloodthirsty female mosquitoes (males do not bite) who are on the wing day and night from early spring until autumn. And if their unsavoury bloodsucking habits and exquisitely itchy bites are not enough, mosquitoes are also the only biting flies in Canada capable of transmitting disease to humans.

Of the 74 species of mosquito known to exist in Canada, 57 occur in Ontario. This number may seem high, but it pales in comparison to mosquito diversity in tropical countries. More than 200 species occur in Costa Rica, a country with less than 1/20th the land area of Ontario. About 3450 species and subspecies are known worldwide.

Nonetheless, some of our local pest species can reproduce prodigiously—particularly in poorly drained areas or when snowmelt conspires with rainfall to create ideal breeding habitat. Snow-pool mosquitoes (*Aedes hexodontus*) in the vicinity of Hudson Bay, for example, may attain population densities approaching 12.5 million per hectare. Little wonder, then, that visitors to the Hudson Bay Lowlands are driven to distraction by these stinging hordes. One can only imagine the misery suffered by mammals and birds.

The first mosquitoes to appear in

Ontario each year are overwintering females of the genera *Anopheles* and *Culiseta*, which come out of hibernation just before the snow melts. Most mosquitoes, in Canada principally members of the genus *Aedes*, overwinter in the egg stage, hatching in meltwaters left by the receding snow (see "Life Cycles of the Small and Bloodthirsty" below). The lifespan of adults is about a month. The presence of mosquitoes in Ontario for up to half the year is largely the result of a succession of different species emerging at various times throughout the summer, although some species are capable of producing multiple generations per year.

The first order of business for adult mosquitoes is mating. Once they've emerged from their pupal skins, they assemble in areas appropriate to the individual species, typically an open area, such as a forest clearing. After mating, the female embarks on her quest for a suitable host from which to draw blood. Most species are unable to mature their eggs in the absence of a blood meal.

In her hunt for blood, the female mosquito is guided to the host by various cues: convection currents, carbon dioxide, moisture, lactic acid, visual stimuli, and chemicals, or "host odours," all play a role. Some people are more attractive to mosquitoes than are others, but relative attractiveness can vary from day to day. Adults are more attractive than children, and evidence suggests that men are more attractive than women.

Unlike some biting flies that use

Life Cycles of the Small and Bloodthirsty

Like most other flies, mosquitoes pass through seven stages to complete their life history: egg, larva (consisting of four successively larger "instars" or phases), pupa, and adult. Eggs are laid on the water or on moist soil near ponds or marshes — anywhere that snowmelt or excessive rain may accumulate and flood the eggs.

For some species, a mere teaspoon of standing water may be enough to support the immature mosquitoes. Small temporary pools of water are ideal for these rapidly developing species because predators are unable to exploit such habitats effectively. For other mosquitoes, marshes up to several hectares in size are suitable, but larger bodies of water, such as lakes, are not because they are subject to wave action, which interferes with respiration during the larval and pupal stages.

The larva, or "wiggler," is little more than a bristly tube with a slightly enlarged front end. The head is normally equipped with a pair of mouth brushes used to gather living or dead plant material. Most species have a siphon projecting from their tail end, which contacts atmospheric air to help the wiggler breathe while submerged. Larvae can swim to the bottom sediments by lashing their bodies rapidly from side to side.

The pupa is a non-feeding stage in which larval tissues are transformed into adult structures. Shaped rather like a comma, the pupa normally rests motionless just beneath the water surface, breathing through a pair of funnel-like "trumpets" situated behind the head. If disturbed, the pupa uses its paddle-like tail to swim downward into the debris on the bottom of a pool. Adults emerge from their pupal skins at the water surface, where they rest until their wings have hardened.

blade-like mandibles to slash their victim's hide, mosquitoes have elongated spear-like ones, which are thrust deeply into the host's skin until they encounter a capillary; then, blood is pumped up through a special channel. At the same time, salivary fluids are pumped into the feeding site to prevent coagulation. These fluids contain proteins that are allergenic to the host—that's what produces the itchy, raised welt, which may persist for days after a bite. A female mosquito may double or even triple her weight after a single meal.

While the vast majority of Ontario's mosquitoes are bloodsuckers, relatively few occur in large enough numbers to be considered serious pests. Perhaps the worst of these is *Aedes vexans*, a scourge that infests many parts of the world. What distinguishes this species from its less prolific relatives is the ability to reproduce rapidly and abundantly during periods of excessive rainfall. Unlike most species of mosquito, which complete only one cycle or generation per year, *Aedes vexans* is capable of producing multiple generations if the weather is favourable.

Pest species that persist in cottage country throughout summer are the aptly named *Aedes excrucians* and *Aedes stimulans*. These large, aggressive species are reddish-brown with

Mosquito Bites and How to Avoid Them

We all know that mosquito bites become itchy almost before the biting female has withdrawn her mouthparts from your skin. The itch continues for about half an hour (the initial reaction) before subsiding, only to return more intensely the following day (the delayed reaction). Victims who are bitten repeatedly develop a degree of immunity—first to the delayed reaction, and then, after many hundreds of bites, to the initial reaction. Unfortunately, immunity to one type of mosquito does not necessarily render a person immune to another type. More immediate relief is provided by astringent preparations such as calamine lotion and zinc oxide ointment.

The best strategy is to avoid being bitten altogether—if you can. All manner of gadgets and concoctions have been devised to assist in this pursuit, some more effective against mosquitoes than others.

Clothing

Because controlling mosquito populations is not practical for most people, perhaps the easiest way to avoid being bitten is to wear appropriate clothing when exposed to bloodthirsty mosquitoes. Loose-fitting long-sleeved shirts and long pants provide protection to the arms, legs, and trunk. Avoid thinly woven, tight-fitting garments as these are easily breached by the female's elongate mouthparts. A head net will keep mosquitoes off the head, and thick socks and gloves will protect ankles and hands respectively (although most people may not wish to wear gloves in summer). It is not necessary to tuck pants into socks as mosquitoes, unlike black flies, will not crawl beneath clothing to bite.

Choice of colour also plays a role in your relative attractiveness to these pests; darker shades such as blues, browns, and blacks are most attractive, whereas lighter hues such as yellows and whites are least attractive. One tactic is to wear blue jeans and a light-coloured shirt. This combination draws mosquitoes away from your face and trunk, where they are likely to be most annoying.

Chemical Repellents

When it comes to chemicals, by far the most effective repellent is diethyl toluamide, or "deet." Brands that have the highest concentration of deet are the most effective, although these are also the most likely to irritate some people's skin as well as damage synthetic fabric and plastic. Lotions may be applied directly to exposed skin, but aerosol formulations work best on clothing. Most brand name aerosols need to be reapplied every hour or so, especially under windy conditions. Longer lasting protection (up to a day or more) is provided by open-weave, parka-like jackets made of deet-impregnated cotton and nylon.

Aromatic lotions and oils

Citronella oil and other aromatic lotions are advanced as pleasant-smelling (and less noxious) alternatives to deet. And although they do provide a modicum of relief, they need to be reapplied so frequently as to render them impractical for prolonged exposure to mosquitoes.

Electronic Devices

Electrocutors or bug zappers, which use an ultraviolet light source surrounded by a charged grid, continue to be advanced as a means for controlling mosquitoes and other pests—despite the fact that studies have proven them to be useless for protection against biting flies. In fact, these instruments are far more effective at killing other insects, many of which are beneficial. The continued use of such destructive contraptions is anathema to anyone concerned with backyard biodiversity. Equally suspect are sonic devices, whose high-pitched noise reputedly repels bloodthirsty mosquitoes: the females are stone deaf and it's only males (who are not interested in your blood) who respond to sounds.

white-banded legs. Farther north, in the boreal forest, *Aedes punctor* and *Aedes communis* torment their unwilling hosts.

Of the few diseases that are potentially transmitted to humans by local mosquitoes, the most important are the arboviruses, which primarily affect wild birds and mammals. Eastern equine encephalitis, St. Louis encephalitis, and the snowshoe hare strain of viruses are transmitted to humans only sporadically, and most people may not even be aware that they are infected.

In 1999, however, concern was raised when the West Nile (WN) virus was discovered in New York State. Seven human deaths were attributed to the disease in New York City and environs. It has been found in crows and other birds (the natural host for this virus) in other northeastern states. The primary carrier of the disease, *Culex pipiens*, occurs widely in southern and eastern Ontario. However, surveillance along the border using "sentinel chicken" traps has so far detected no occurrence of WN virus in Canada.

Malaria, by far the world's most devastating parasitic disease, flourished in southern Ontario in the 1800s. The causative organisms are species of *Plasmodium* protozoa (single-celled parasites), transmitted to humans by the mosquito genus *Anopheles*. All five species of *Anopheles* found in Ontario can transmit malaria under experimental conditions, but fortunately, the disease has long been eradicated from Canada and the United States.

Now that we're into the dog days of summer, and with the prospect of cooler autumn temperatures on the horizon, perhaps relief is finally in sight. But before you plan your traditional Labour Day barbeque, you might want to check the weather forecast. Late August rains virtually guarantee that *Aedes vexans* and its kin will be dining on you come September. Remember to have your repellent handy, and be happy that our climate is generally unfavourable for the myriad diseases that mosquitoes may carry. To borrow a quote from an entomological bumper sticker, Let us Spray.

Doug Currie is a curator of entomology in the ROM's Centre for Biodiversity and Conservation Biology.

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By Oliver Headrath and Allan J. Baker

Wanderers

How flightless birds came to be strewn across far-flung continents.

The ostrich has the dubious distinction of being the only bird whose eyeball is larger than its brain. With its impressive size and comical appearance, the ostrich and its fellow large, flightless birds, such as the emu, are often favourites to visit at the zoo. Ornithologists, too, are intrigued by these birds and their close relatives—known as

ILLUSTRATION BY JIM STEWART

ratites—because of the mystery surrounding how they may have descended from flying bird ancestors in the ancient past.

Over the past 100 years, ornithologists and evolutionary biologists have debated how these flightless birds might be related to one another, and to other birds. Their group includes the ostrich from Africa (and formerly Arabia), two species of rhea from South America, the emu from Australia, three species of cassowary from Australia and Papua New Guinea, and at least four species of kiwi from New Zealand. Up until a few centuries ago, ratites also included two other lineages—true giants in the bird world—the moas of New Zealand and the elephant birds of Madagascar, both now extinct. Moas were probably the tallest birds that ever lived, with the largest of the 11 species reaching 4 metres (more than 13 feet). Elephant birds, as their name suggests, were even more massive, although shorter than the moas, and likely weighed up to 500 kilograms (1100 pounds).

BRIAN BOYLE, ROM

Ancient DNA samples were taken from a skeleton of the now-extinct moa, like the one shown here from the ROM's collections.

Their widespread distribution across the southern continents of the world has prompted scientists to ask how ratites came to live on so many separate continents. Did they all descend from a common ancestor? Or did they evolve independently from different groups of flying birds?

It turns out that these big birds have had a much travelled past, one that was a mystery to biologists until the recent advent of DNA techniques. Advances in molecular biology—which have allowed scientists to sequence several-thousand-year-old DNA—have helped considerably in answering these questions. But help in finding answers has come not just from the realm of biology. Understanding plate tectonics—how and when the continents move across the globe—has also been instrumental.

For ornithologists working in the 19th and early 20th centuries, who viewed the continents as immobile, it seemed inconceivable that these birds could have originated from a common ancestor, and then spread to such distant and unconnected land masses without being able to fly. Many scientists argued that ratites descended from several lineages of flying birds and that any shared traits were merely a product of convergent evolution—that is, similar adaptations of unrelated birds to cope with similar lifestyles.

Other scientists, such as Thomas Huxley, a colleague of Charles Darwin, argued that the ratites should be classified as one group of closely related birds. For one thing, they all had a flat breastbone, or sternum. This was the reason for the name ratite—the Latin word *ratis* refers to a keel-less boat. The flat breastbone appeared to be a trait that linked the group, although we now know that all birds, upon losing the ability to fly, slowly lose the keel on their sternum. Flying birds, by contrast, have a keeled breastbone to which flight muscles are attached.

In 1867, Huxley made a detailed study of ratites and uncovered another distinguishing feature—a unique pattern to the bones in the palate of the mouth, now referred to as the paleognathous palate. This structure was shared only by the ratites and their closest living relatives, the tinamous.

Almost another century passed, however, before several new lines of evidence tipped the balance in favour of accepting Huxley's belief that the ratites were a group of related birds. In the late 1960s, molecular studies of proteins

showed that ratites are more closely related to one another than to any other bird. This data was corroborated by behavioural, chromosomal, and morphological (bone structure) studies.

At the same time, the concept of continental drift was becoming widely accepted among scientists. The continents were no longer viewed as stationary, but as moving slowly across the globe and occasionally colliding and fragmenting. Reconstructions of Earth's geological past revealed that all the land masses currently inhabited by ratites were—until about 100 million years ago—joined together in a supercontinent known as Gondwana. This removed one of the greatest obstacles to recognizing that the ratites were descended from a common ancestor—their wide and disjunct distribution was no longer an issue.

In 1974, a new theory emerged: the common ancestor of the ratites might have been flightless already and widely distributed across Gondwana—which had been composed of Africa, South America, Australia, New Zealand, and Antarctica (at that time, Antarctica had a temperate climate, supporting dinosaurs and plants). As the supercontinent began to break up, the ratites would have become separated on different continental "lifeboats," drifting away to their current locations. This genetic isolation started them on different paths of evolution, culminating in the modern species we know today. The "lifeboat" hypothesis became widely adopted, and ratites were soon used as a textbook example of evolution being shaped by continental drift.

But the world of science does not sit still for long, and in the early '80s, a revolutionary new field—molecular biology—provided a tool to test the hypothesis: DNA sequencing. DNA is the genetic material passed on from one generation to the next. It is composed of a four-base code (A, C, G, T) strung in pairs along a linear sequence in a long molecule. Sequences range in size from millions of base pairs for a simple bacterium to billions of base pairs for a complex organism such as a human being.

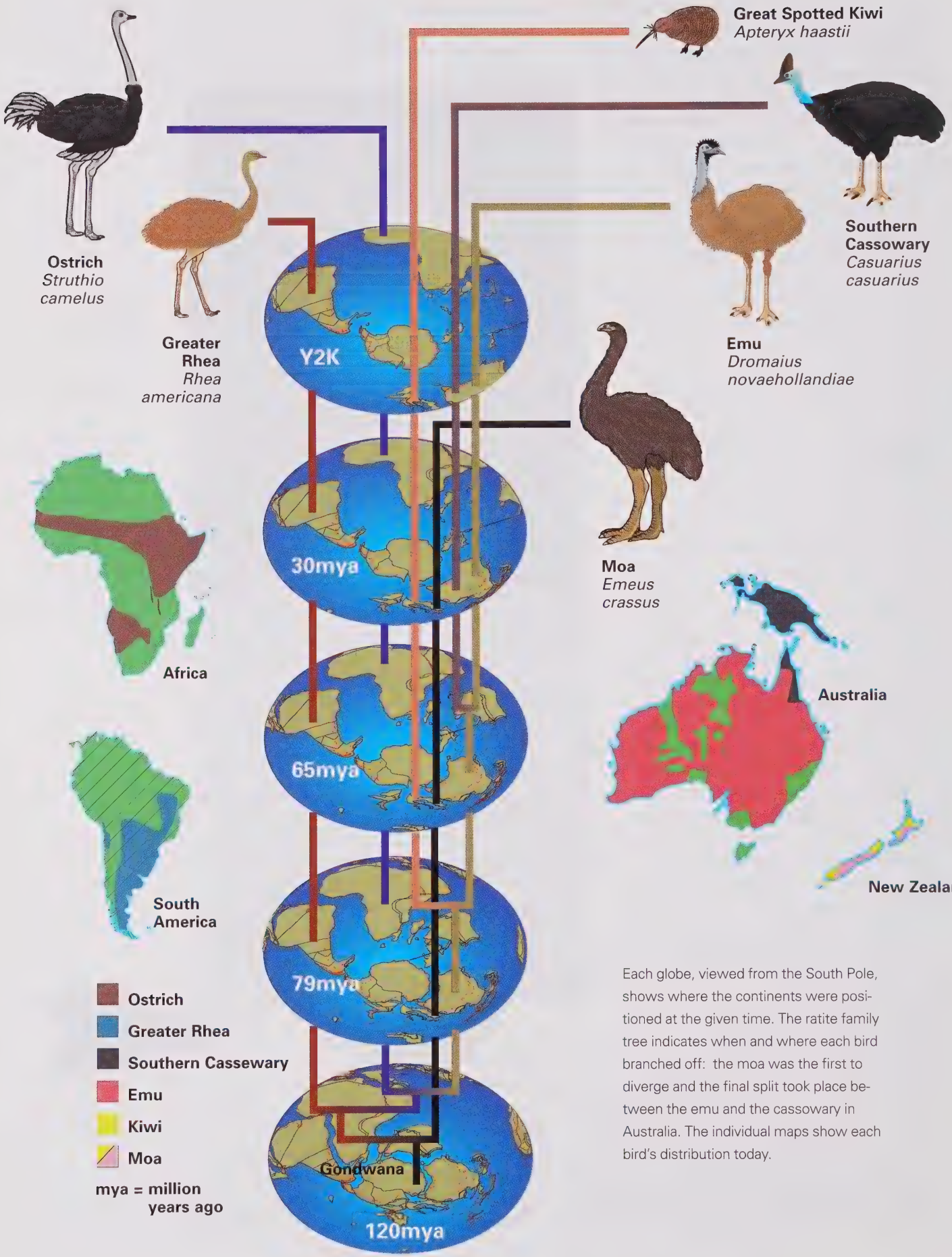
Essentially a blueprint of the organism, DNA contains an abundance of information that tracks a species' history. Scientific advances gave us new methods for recovering DNA from both living and extinct animals, and researchers pioneered ways of measuring the random mutations that accumulate in DNA over vast periods of time. If enough mutations have built up in a given animal, it becomes a different species altogether. Such mutations can be used to determine when speciation events—when one species branched off from another—took place.

Left: All the large flightless ratites and their close cousins the tinamous share a unique bone structure in the palate—called a paleognathous palate. Below: The flat breastbone of an ostrich (left) is typical of flightless birds. The swan breastbone (at right), like that of most birds, has a keel to which flight muscles are attached.

In recent years, DNA sequencing has been used increasingly in determining the relationships among different organisms.

During the 1980s and 1990s, a number of researchers conducted studies on DNA variations in the ratites. While these produced some consensus—in demonstrating a close relationship between the emu and cassowary, for example, and that kiwis were the next closest relatives of the two—the relationships among the other ratites varied from study to study. The only common conclusion drawn by all researchers was that the ratites diversified relatively rapidly a long time ago.

To clear up the findings of these previous studies, we needed more information. Our aim was, first, to compile a complete evolutionary tree (or phylogeny) for the ratites—to show us how they



Each globe, viewed from the South Pole, shows where the continents were positioned at the given time. The ratite family tree indicates when and where each bird branched off: the moa was the first to diverge and the final split took place between the emu and the cassowary in Australia. The individual maps show each bird's distribution today.

are related to each other—and, second, to find evidence that would accurately date the point when each bird branched off the tree. The key was to accumulate a large amount of DNA from as many ratites as possible.

In previous studies, sequences of only a few hundred to a few thousand base pairs had been used. Our study aimed to sequence a complete mitochondrial genome for each bird. The mitochondrion is a small energy-producing organelle in living cells. The genome it contains is a circular piece of DNA composed of about 17,000 base pairs. In animals, the mitochondrion is the only place outside the cell's nucleus where DNA is found. We took sequences from the ostrich, lesser rhea, southern cassowary, great spotted kiwi, and two species of extinct moas.

Prior to our study, only one other analysis had included DNA from extinct moas—and it used only about 400 base pairs. Including moas was critical to our work, because they were believed by some to be the first ratites to differentiate from the common ratite ancestor, although this proposal has always been controversial. Obtaining such large sequences of DNA from these extinct birds proved to be a huge technical challenge. The DNA had to be recovered from bone fragments several thousand years old. The process took two years (see "What Can Ancient DNA Tell Us," at right).

It was well worth the effort. When we analyzed DNA from all of our study birds, a clear picture emerged of where each should be placed on the ratite family tree. The birds are, as has long been thought, a closely related group descended from a common ancestor. We found that the moa was, indeed, the first ratite lineage to branch off at the base of the tree—as has also been found in the only two published morphological studies. Next to branch off was the rhea, followed very shortly thereafter by the ostrich. The kiwi split off next, and the final divergence was between the emu and cassowary.

We now had a tree based on reliable data. But the second part of our study was to figure out how the birds ended up on so many different continents. To determine this, we needed to date the times that each of the species diverged. These times would tell us whether the ratites were likely spread passively by plate tectonics or if flight or island-hopping was required to get them to where they live today.

DNA sequences can help give us the timing—provided that some fossils are available. Fossil data allow us to convert the lengths of the tree branches into specific times of divergence because precise dates can be obtained for fossil material. We used a fossil ratite, dated to 25 million years of age, as a basis for our calculations.

What Can Ancient DNA Tell Us?

Despite early claims that DNA was being extracted from dinosaur remains—sparking the imagination and leading to such movies and books as *Jurassic Park* and *The Lost World*, in reality, DNA has not proven to be quite so indestructible. To date, there have been no proven examples of recovering authentic dino DNA, and the opportunity to see living dinosaurs at your local zoo is not likely to present itself any time soon. Most scientists agree that the survival of DNA beyond 100,000 years remains unlikely, because over such a length of time it becomes irreversibly degraded.

Yet this time span still allows a wide number of questions to be addressed using ancient DNA. Scientists have been able to compare DNA from the mammoth to that of its living relatives, the African and Indian elephants. And a comparison of DNA extracted from the bones of Neanderthals to that of modern humans has shown that we replaced the Neanderthals.

The difficulty in working with such ancient genetic material is that it usually is damaged and broken into small pieces and is prone to contamination by DNA from living species. In our ratite study, we reassembled a complete mitochondrial genome sequence—measuring 17,000 base pairs—with degraded DNA. This is something like putting together a jigsaw puzzle—without knowing what the final picture will look like. Short pieces of DNA, each ranging in size from 300 to 500 base pairs in length, need to be pieced back together in the correct order. Finding pieces that have overlapping sequences is the key to this painstaking work.

Two Types of DNA: Which is Better?

DNA can be found in two different places in the living cells of animals—in the cell's nucleus and in a small energy-producing organelle called a mitochondrion. Scientists use both types in their research. But mitochondrial DNA has many advantages over nuclear DNA. For one thing, it is easier to extract, especially from ancient specimens. Each cell has hundreds of mitochondria but only a single nucleus. And because mitochondrial DNA is passed along directly from the mother—as an exact copy—it is easier to interpret. Perhaps most significantly, though, is that mitochondrial DNA evolves, on average, 10 times faster than nuclear DNA—allowing more mutations to accumulate in a shorter period of time.

Comparing its bones to those of the modern emu and cassowary showed that this fossil bird was already on its way to becoming an emu. This tells us that emu and cassowary diverged earlier than 25 million years ago, likely 35 million years ago.

ANDREW GIVEN

OLIVER HADDRATH

Top: Nobody knows exactly how the flightless ostrich made it to Africa, where it lives today. Middle: Emus split from their close relatives the cassowaries within Australia. Bottom: Forest-dwelling cassowaries developed a dagger-like claw on the inner toe and a helmet-like casque on the head, neither of which is found in the other ratites.

With the fossil date in place, we went back to work with the DNA. By counting the number of mutations that had accumulated between the emu and cassowary in those 35 million years, we obtained a rate of mutation that we used to date all the branch points in the ratite tree. Think of how you can calculate the age of a sugar maple from its height if you know how many feet it grows per year.

With these times pinned down, we could now check how they fit with the timing of Gondwana's breakup. If a bird differentiated from the others *around the same time or before* its home continent drifted away from Gondwana, the bird's current location can be explained by continental drift. But if the branching off occurred *after* the bird's home continent broke away, the bird would have needed some other means of transportation to get to where it lives today. We found that most, but not all, of the present distributions of the ratites can be explained by continental drift.

The moas split from the other ratites some 79 million years ago, around the time that New Zealand broke away from Gondwana. This is certainly consistent with the idea that the moa ancestor was already on New Zealand when it separated. The rheas split off about 69 million years ago. They, too, fit this hypothesis, as South America didn't separate from Antarctica until about 35 million years ago. The common ancestor of the Australian ratites also branched off the ratite tree at about the time Australia went its separate way 55 to 65 million years ago, with the later split between the emu and cassowary 35 million years ago likely taking place within Australia.

But two ratites do not neatly fit the continental fragmentation hypothesis: the kiwis and the ostrich. Confirming the results of previous studies, we found that the kiwis split from the common ancestor of the emu and cassowary. This occurred about 62 million years ago—18 million years too late to be on the New Zealand landmass when it broke away from the supercontinent. The most plausible explanation of how they subsequently ended up in New Zealand is island-hopping along the Lord Howe Rise. At various points in history, this chain of underwater islands anchored on a continental plate fragment broke above the water level, exposed by fluctuating sea levels. Over time, the plate fragment drifted from a position relatively near Australia to its current location, tucked against New Zealand. A significant influx of other plants and animals are also thought to have invaded New Zealand by this same route.

The hardest ratite to reconcile with the

break-up of Gondwana is the ostrich. Geophysical estimates put Africa's split from South America (and from the rest of Gondwana) at about 100 million years ago, 35 million years before ostriches branched off the ratite tree. If Africa really did split from Gondwana so early, how did ostriches get there?

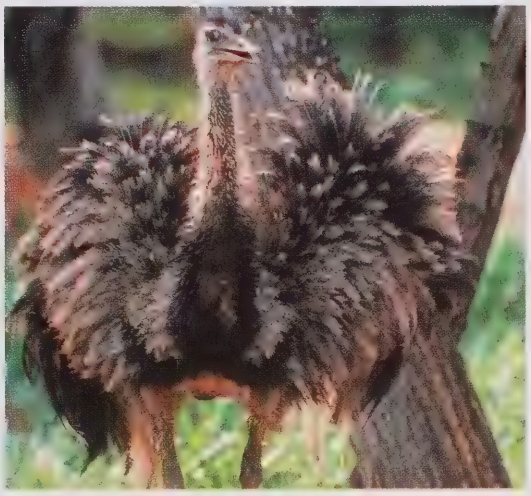
Three possible scenarios exist. The ancestral lineage of the ostrich may have moved northward through South America and walked across islands in the Atlantic to reach Africa. The second possibility is that some 80 million years ago, the ancestral ostrich travelled from Antarctica to the India/Madagascar plate via a land bridge that existed then. From there, one lineage of the ostrich ancestor could have island-hopped across the Mozambique Strait and into Africa, later becoming the ostrich we know today. The birds that didn't cross the strait perhaps differentiated into the elephant birds that once lived in Madagascar. A third possibility is that the ostrich ancestor stayed on India when it broke off from Madagascar and rafted north with it until the landmass collided with Asia, then travelled overland to reach Africa. Nobody is really sure which route the ostriches took.

The extinct elephant bird may well provide the final piece of the puzzle. If the ostrich and elephant bird separated about 80 million years ago, and each is the other's closest relative, then it's likely the ostrich did cross into Africa from Madagascar. Already, we are extracting elephant bird DNA from museum bone samples, leading into the next chapter of our work.

We are now certain that the ratites were greatly influenced by the breakup of Gondwana between 80 and 35 million years ago. Today, these birds are undergoing yet another large range expansion, and as in the ancient past they are largely passive participants. This time their distribution will be global, and the driving force behind this move is not plate tectonics but modern farming.

Ratite farming has become big business around the world during the last decade as farmers have come to recognize that these birds can supply many useful products. In particular, their meat is healthy: low in fat, it contains three times the iron found in beef. Ostrich, emu, and rhea can now be found on farms in Canada and around the world from Sweden to Africa.

If you ever visit an ostrich farm, remember that these big birds have a nomadic past, one that biologists are only now unravelling with the latest DNA techniques. These methods helped us not only to decode the origins of life forms but also to date the branching points on the tree of life. Museum collections—especially in the departments of life sciences and palaeontology—hold a treasure trove of specimens and DNA that will enable scientists to document many more chapters in the history of life on our planet.



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AUKLAND MUSEUM, NEW ZEALAND

MARYANN BURBIDGE

Top: Aboard the South American continent, rheas sailed away from their relatives about 35 million years ago. Middle: Now extinct, the moa was the tallest bird on earth. It lived in New Zealand. Bottom: Though the kiwi lives in New Zealand today, we now know it hitched a ride there from Australia long after the moa was already established.

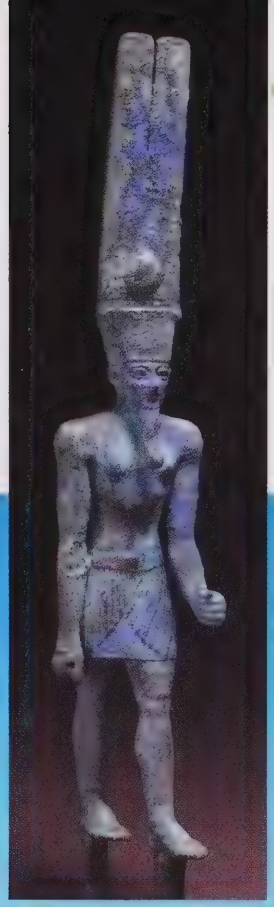
By Julie R. Anderson and Krzysztof Grzymski

Land of the Hidden

Dangeil. Left: Stairs up the pylon in a recently discovered 2000-year-old temple in Dangeil. Below: Statue of Amun, depicted here as a ram-headed man. Background image: The gates of Dangeil before excavation.

For years, ancient temples in northern Sudan have been overlooked by scholars and archaeologists. Today, experts are waking up to the treasures buried in the sands.

Temples



SOME 3000 YEARS AGO along the banks of the Nile, a civilization sprang up in ancient Sudan, one reminiscent of Pharaonic Egypt. While cultural and ethnic differences did exist between the two civilizations, they agreed about one critical thing—the importance of the god Amun. Both elevated him above other gods of the day to the position of state god.

Amun is probably most familiar to people through Tutankhamun, the pharaoh whose name translates as "the Living Image of Amun." It was common practice among Egyptian pharaohs to incorporate the god's name within their own. Yet, despite this tradition, the first mention of Amun, in Egyptian texts about 2350 BC, associates the god with Punt (in the modern-day horn of Africa) and Nubia (modern-day Sudan), where he is known as

Meroe. Top: Sculpture of Amun. Right: Local workers help excavate the Amun temple at Meroe.

Amani. It has even been speculated that the cult of Amun originated not in Egypt, as might be suggested by the many Amun temples there, but in Nubia.

Whatever the true origins, myths about Amun suggest that he was a creator god. In ancient art works—such as the numerous reliefs and sculptures of Amun in the ROM's Egyptian and Nubian galleries—he is portrayed as a man wearing a feathered headdress, a ram, or a ram-headed man. The ram was an important symbol of fertility to peoples who depended extensively on the abundance of their flocks. Often, Amun is shown as part of a divine family triad together with the Goddess Mut and the child Khonsu. Though he may be best known as the most important deity of the Egyptian empire during the New Kingdom period (1550—1070 BC), Amun's origins and nature remain shrouded in mystery, apparent even in the name itself, which means "the Hidden One."

What little we know of Amun worship comes from a few ancient texts and from the excavation of Amun temples. The largest and most famous of these temples is in Karnak, Egypt; it is well known to scholars and has been studied extensively, as have most of the Amun temples in Egypt. Yet many others in northern Sudan have been largely overlooked by scholars. Until recently—likely because the harsh climate and difficult working conditions are discouraging—Sudan has been ignored almost completely by archaeologists.

Today, the region is enjoying something of a renaissance: more than 30 archaeological expeditions from nine countries, including Canada, the United States, France, Switzerland, and Britain, have begun to investigate the magnificent remains of the second great civilization of the Nile Valley, and Canada has proved to be one of the leaders. ROM researchers have been working in Sudan for almost 25 years. By designating the ROM's work as an official activity of the United Nation's Decade for Cultural Development, UNESCO has recognized the Museum's contribution in discovering and preserving Sudan's world heritage monuments, structures, and sites that are becoming increasingly threatened by ongoing modernization and development.

This work is just beginning. The ROM's latest findings reveal that many Amun temples may still lie hidden in unexcavated ruin beneath the shifting sands of the Nubian Desert, temples that some day will reveal new insights into the ancient Nubian civilization—and its worship of Amun.

The Crowning of Kings at Gebel Barkal

NUBIOLOGISTS HAVE KNOWN ABOUT the largest of Sudan's Amun temples for 180 years. Initiated by Egyptian pharaohs of the 18th Dynasty (1550—1295 BC), this temple is located at modern day Gebel Barkal (ancient Napata), just downstream from the 4th cataract of the Nile. In the 8th century BC, when Nubian kings conquered Egypt—where they ruled for almost a century—the temple at Gebel Barkal was expanded, becoming the religious centre of the Nubian Kingdom. It remained so throughout the Napatan-Meroitic Period (800 BC—AD 350)—known to some scholars as the Kushite period—when it was believed that Amun lived within the holy Barkal Mountain.

In this temple Nubian kings were crowned. We know from inscriptions written in Egyptian hieroglyphs that, upon ascending the throne, a new king would depart from the capital city, beginning a coronation journey from the temple to visit other large Amun temples in Sanam, Kawa, and Tabo. Ancient texts suggest that the coronation tradition continued at Gebel Barkal even after the royal residence was transferred south to Meroe around 600 BC.

KRZYSZTOF GRZYMSKI, ROM

In the first person: Julie Anderson in Dangeil

A GRUELLING, NINE-HOUR JOURNEY brought us to the little-known Berber-Abidiya region of northern Sudan, to investigate the site of an abandoned Nubian city called Dangeil. Its desolate appearance is uninspiring—a flat, gravelly desert stretches as far as the eye can see—but the history of Dangeil is compelling. Here, among the rubble, we made an astonishing discovery—a well-preserved previously unknown temple.

It was the spring of 2000, and our mission was led by myself, Dr. Julie Anderson of the Royal Ontario Museum, and Dr. Salah M. Ahmed of the National Corporation for Antiquities and Museums, Khartoum.

North of Abidiya, the rocky rapids of the Nile's 5th cataract cut across the river and travellers must journey around them, through the desert. Near Dangeil, the desert routes converge and rejoin the river. French travellers and scholars such as Linant de Bellefonds and F. Cailliaud, who accompanied a Turko-Egyptian invasion of the Sudan in the early 19th century, passed through the area and made note of Dangeil's red bricks and ruins.

"On the 10th, we left an hour and a half after sunrise," wrote de Bellefonds on April 10, 1822, "and while passing the mountains of Narrara [Gebel Nakharu] I passed in a small village named Danguelle [Dangeil] the remains of a well-built city of baked bricks. There is nothing left, only rubble which the people of the country name the 'Canisse.'"

Then, early in the 20th century, J. Crowfoot, a British archaeologist responsible for the antiquities of Anglo-Egyptian Sudan, visited Dangeil briefly and discovered that a granite block being used by the village women to do their laundry contained an inscription in the Meroitic language. Although the artifact was transported to the Khartoum museum in the 1950s, until the ROM project began, the archaeological site of Dangeil remained uninvestigated.

De Bellefonds' description does not do the site justice. Dangeil, which means "red brick rubble" in Nubian, is large and imposing. The site, measuring 300 x 400 metres (327 x 436 yards), is about the size of 24 football fields and has a fortified enclosure in the centre. Ruins of a large tower are visible on the southeast corner of the ancient wall and a monumental entry gate guards the west side. Several enigmatic mounds of earth, some rising more than 4.5 metres (15 feet) above the surrounding plain, dot the site. Potsherds, sandstone pieces, and many red brick fragments lie scattered across the ground.

Gauging from the ceramic fragments, the site dates to Nubia's late Meroitic

JULIE R. ANDERSON, ROM

Dangeil. The ruins of a 2000-year-old temple were found last spring in Dangeil, Sudan.

JULIE R. ANDERSON, ROM

Dangeil. After comparing the temple's architecture to others in Sudan, it became clear this was a temple to the god Amun.

period, 1st to 2nd century AD. After making a topographic plan, we realized that each mound appeared to represent a discrete building. We decided to start with a mound ("kom" in Arabic) in the centre of the site, which we designated as Kom H, thinking that it was likely the focal point of the site in ancient times.

As we dug into the mound, we began to turn up Meroitic pottery, red brick architectural fragments, including cornice and torus mouldings—a convex moulding, usually found at the base of a column—and large numbers of bread moulds, some with remnants of the ancient bread still intact. Archaeologists often associate bakeries with temples because bread was needed for offerings as well as for feeding the priests and temple personnel.

Dangeil. Inside the entrance to the Amun temple, a floor is paved in sandstone slabs. Grooves made by the heavy temple doors are still visible.

JULIE R. ANDERSON, ROM

Eventually, our efforts revealed the northern half of a monumental red brick temple gate, still standing 3.5 metres (11 1/2 feet) high in places. The gate measures almost 34 metres (37 yards) long and 5.5 metres (18 feet) wide, almost the size of three city buses end to end and stacked two deep —and the southern half of the pylon is not yet fully exposed. In the entry, we discovered a floor paved with sandstone slabs; there were two large curved grooves still preserved in the floor, made during the Meroitic period by the heavy temple doors.

Further excavation brought us into a columned forecourt, where six white-plastered columns studded the interior and a stairwell led up one end of the pylon. Eastward, towards the likely location of the god's sanctuary, we unearthed a second gate and court.

Could this be an Amun temple, we wondered. During the Meroitic period, the Nubians worshipped several gods. Inscriptions and reliefs that mention or depict Amun are excellent indicators that a temple is dedicated to him, but other clues found in structural details are equally convincing to archaeologists. In front of the temple's main gate, a red brick pedestal base was partially exposed—perhaps it held a ram statue. Rows of ram sculptures are a distinguishing feature of Amun temples.

After comparing the building plan to those of known Amun temples at Sanam, Tabo, and Kawa—all in Sudan—it became apparent that Dangeil was home to none other than an exceptionally large and well-preserved 2000-year-old temple to the god Amun—a temple previously unknown in modern times.

JULIE R. ANDERSON, ROM

Dangeil. Bread moulds, like these, are frequently associated with Meroitic temples. These moulds were handmade and used only once.

When we more closely examined the topographic site plan and surface material, we began to suspect that yet another temple sits just to the west of Kom H, perhaps dedicated to Mut or Khonsu—the other members of the Amun family triad—or perhaps to Apedemak, the native Nubian Lion God. But that is a question that only future excavation can answer.

In the first person: Krzysztof Grzymski in Meroe

ONE HUNDRED AND FIFTY KILOMETRES south of the desolation at Dangeil, the ancient royal city of Meroe, Sudan, is surrounded by savannah-like grasses and abundant acacia-trees. Here, another ROM project is being co-directed by myself, Krzysztof Grzymski, and Dr. Ali Osman of the University of Khartoum. The site is prettier than Dangeil, but excavation work in the Amun temple of this ancient Nubian capital is not any easier.

Sudan's scorching heat often reaches 48°C (126°F) and is interspersed with violent sandstorms. The desire to cool off in the Nile is tempered by crocodiles who swim the waters. Routinely, workers find scorpions, and last season we killed a highly venomous viper found hiding in a hole under the temple walls. At times like these, the lengthy gap in archaeological explorations of the Middle Nile seems quite understandable.

Some 200 km north of Khartoum, ancient Meroe was Nubia's capital and the residence of the Kushite kings from at least the 5th century BC and extending to the 4th century AD. Basil Davidson, a renowned British writer and historian of the 1950s and 1960s, considered Meroe to be the largest archaeological site in sub-Saharan Africa.

First described by Greek historian Herodotus around 480 BC, Meroe's location became lost in antiquity and remained a mystery in the West for centuries. The site was tentatively identified in Sudan by the likes of Cailliaud early in the 19th century, but it was the excavation work of John Garstang of the University of Liverpool between 1909 and 1914 that at last confirmed the location. Further work, conducted by Professor Peter Shinnie off and on from 1965 to 1984—first on behalf of the University of Khartoum and later for the University of Calgary—provided some information for historians and archaeologists (see "Royal Meroe: An Archaeological History," page 29). Yet only a small part of the site had been unearthed, and the hurried way in which Garstang excavated and published the remains of royal palaces and temples necessitated new research.

So when the University of Khartoum invited the ROM to continue the joint Canadian-Sudanese excavations begun by Shinnie, we accepted, and the Toronto-Khartoum expedition began field operations at Meroe in October 1999. Unlike earlier investigations, our project addresses site preservation. It also offers tangible economic benefits to some of the poorest villagers and internally displaced people in this war-torn country.

Meroe. The Amun temple at Meroe was carefully preserved before excavation began.

KRZYSZTOF GRZYMSKI, ROM

KRZYSZTOF GRZYMSKI, ROM

Meroe. The ROM's project in Meroe not only helps protect the site, but offers tangible economic benefits to some of Sudan's poorest villagers.

Meroe. An exciting discovery at the Amun temple was this block bearing the name of King Anlamanai written in Egyptian hieroglyphs.

KRZYSZTOF GRZYMSKI, ROM

KRZYSZTOF GRZYMSKI, ROM

Meroe. The team discovered many carved blocks at the Amun temple like this one — covered with what may well be ancient graffiti.

In recent years, Meroe's popularity as a tourist destination has placed stresses on the city's vulnerable walls and buildings. Also, Meroe lies within a rain belt, and the rainy season from July through September leaves the city's ancient buildings, made of soft Nubian sandstone, vulnerable to further damage.

On the advice of our conservators, we took pains to protect the site before excavating. We cut the trees growing on the city and temple walls to discourage goats from climbing on and destroying them. We removed at least some of the spoil heaps left by previous excavators. While this made the site more attractive for visitors, more importantly it helped to redirect the flow of water away from endangered structures.

Perhaps the greatest danger to an ancient site, though, is hasty excavations: our team spent hundreds of hours walking over the entire site and recording surface material before excavating. This paid off with a number of pleasant surprises: we identified errors in published plans of various buildings, noticed numerous inscriptions and graffiti, and recorded the location of many beautifully carved blocks. Perhaps the most exciting discovery was a stone block bearing the name of the Kushite King Anlamani (c. 620–600 BC) written in Egyptian hieroglyphs within an oval cartouche.

Our excavations focused on two areas: parts of the Amun Temple, and mound M712, an area identified but not excavated by Garstang. The temple is the second-largest built by the Meroitic rulers and it is the biggest building in the city of Meroe, yet it has never been adequately studied. It seems that Garstang did not publish the complete plan; the temple was never fully excavated. Only the interior was cleared. Even within the excavated areas, the walls were not fully exposed, and some elements of the plan were mere conjectures.

This lack of precision led many scholars to propose various hypotheses about the temple's architecture; our recent excavation work proved all these suggestions wrong. We were able to trace the wall outlines of the massive 60-metre- (65-yard-) long courtyard; we identified the exact location of the supposed south entrance; we recorded numerous graffiti and reliefs; and last but not least we discovered and partly excavated two long stairways leading up the first pylon, similar to ones in Gebel Barkal and Dangeil. These features in Meroe's Temple of Amun, "the Hidden One," went unrecognized by previous excavations. We can only speculate how many others remain hidden within the temple enclosure.

Our purpose in excavating at the second Meroe site, mound M712, located close to the processional avenue, was to determine whether it was once homes or another temple. The maze of mudbrick and red brick walls, and

the animal bones, sherds of utilitarian pottery, grinding stones, and hearth remains all point to the area's domestic use.

And yet, as often happens on archaeological digs, the last day revealed a new find: in the north end of the trench was a fragment of an excellent-quality red brick wall. Was it a yet another hidden temple? Our patience will be sorely tested as we wait until October, the next season at Meroe, to find the answer.

From what we uncovered in just this one field season, we now know that in Sudan many amazing cultural treasures remain hidden in the desert and along the banks of the Nile. The temples being unearthed in the middle Nile Valley promise to throw new light on one of the world's greatest civilizations. •

Royal Meroe: An Archaeological History

The location of the ancient royal city of Meroe, recorded by Herodotus in 480 BC, was lost over time to researchers in the West. More than 23 centuries later, through the work of John Garstang of the University of Liverpool, it was positively identified in modern-day Sudan.

Garstang's excavations were underwritten by a number of wealthy individuals and institutions, who in return for their financial support, were given a selection of the finds. Research in the archives of the Royal Ontario Museum and in the University of Liverpool revealed that on the recommendation of ROM founder, Charles T. Currelly, the Museum's first chairman, Sir Edmund Walker, became one of the subscribers to Garstang's Meroe project. Walker's share of the finds forms the core of the ROM's Meroe collection today. The collection was subsequently enhanced by a gift from another of Garstang's supporters, Sir Robert Mond, founder of Inco and a well-known benefactor of the Museum.

Garstang's work focused on checking the reality of Meroe against what had been written by Greek and Roman scribes. Although by modern standards, his excavation techniques left much to be desired, Garstang succeeded in unearthing a large part of the royal district of Meroe with its many palaces, storage magazines, shrines, and other buildings. He also discovered a large temple of Amun. Nevertheless, large areas of the site remained unexcavated, and it was not until 1965 that new work began.

Under the directorship of Professor Peter Shinnie, these excavations were carried out, off and on, until 1984, first on behalf of the University of Khartoum and later as a joint mission with the University of Calgary. Once again, the ROM extended its support to the project, albeit on a very modest scale.

Shinnie's excavations concentrated on the domestic and industrial area of the ancient town, revealing numerous iron-smelting furnaces. Heaps of iron slag still visible on the surface led one early traveller to dub Meroe "the Birmingham of Africa." Another important discovery revealed several temples that apparently formed a processional avenue leading to the Amun Temple.

Top: Temples at both Dangeil and Meroe are dedicated to the god Amun, often portrayed as a ram-headed man. Bottom: Krzysztof Grzymski beside the altar of the Amun temple at Meroe.

BRIAN BOYLE, ROM

NEAC ARCHIVES

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By William M. Glenn

Eve of Ex

Five times in the past billion years, cataclysmic forces have ripped the global ecosystem to shreds. Now, scientists warn we may be poised on the brink of the sixth great extinction.

TINCTION

Extinction is inevitable. Every new species is fated to slither or scamper or skitter for only a finite time upon the Earth. Inexorably, a changing environment strips away a species' evolutionary advantages. Or its unique ecological niche is wrested from it by a faster, stronger, or more wily competitor. While tragic for those involved, extinction is not always a bad thing, environmentally speaking.

In just the last two centuries, an unexpectedly large number of species have disappeared — more than 100 kinds of birds, 80 species of mammals, and uncounted invertebrates and plants. Many more are threatened.

When the rate of extinction is in balance with the rate of speciation—the evolutionary engine that generates new kinds of plants and animals—biodiversity is maintained. When the two rates shift out of alignment, however, it's time to start worrying. That's when we're playing environmental roulette.

Since the debut of the first single-celled life forms on Earth some one billion years ago, periodic waves of extinction have swept away the old eco-regimes, often clearing the stage for the next contestants in the evolutionary pageant. The fossil record displays evidence of five massive die-backs—staggering shifts in the fabric of life—interspersed by minor spasms of growth and extinction. On each of these five separate occasions, 70 to 95 percent of the world's then-existing species disappeared forever over a relatively short time period on the geological scale (see "Tides of Change," page 33).

"Much as war and upheaval are the primary dating points of human history," explains paleontologist Dr. Hans-Dieter Sues, the ROM's vice-president of Research and Collections, "the history of life is punctuated by the great waves of extinction." These mark the major transitions in the Earth's living history.

One of these transitions may now be underway. Despite difficulties in determining exact comparative rates of extinction, today's scientists are gathering mounting anecdotal and statistical evidence to suggest that the balance of life on Earth is being fundamentally and irreversibly altered yet again. It appears that humankind is intent on knocking the balance completely out of whack. Are we on the brink of the sixth great wave of extinction?

"Absolutely, no question about it," says Dr. Allan Baker, ornithologist and head of the ROM's Centre for Biodiversity and Conservation Biology. If things don't change, he says, 30 to 70 percent of all the species in the world will disappear, if not in our lifetime, then during the lives of our children.

Losing large numbers of relatively unknown species may seem like an abstraction. But the reality is that we are all connected by the same web of life, and humankind may very well be one of the species that doesn't manage to survive.

In just the last two centuries an unexpectedly large number of species have already disappeared—more than 100 kinds of birds, 80 species of mammals, and uncounted invertebrates and plants. Many more are threatened. According to the World Conservation Union's most recent "Red List," a further 24 percent of mammal species, 25 percent of reptiles, 20 percent of amphibians, and 30 percent of the (mostly freshwater) fish species so far assessed are threat-

ened with extinction. Thousands more fall into the WCU's lower-risk "near threatened" category.

Among the birds alone, one in eight of the approximately 9000 known species currently face a high risk of extinction. Another 727 are on the vulnerable "near threatened" list. Baker rattles off example after example: the number of kiwis in New Zealand has dwindled at an alarming rate over the last 20 years; North American warbler populations are in a nosedive; the numbers of European skylarks and swallows have been halved since 1970.

Estimating from fossil evidence, it seems reasonable to expect to lose one bird species every 100 years during "background" extinction levels that prevail between cataclysmic die-backs. Yet, since 1800, some 106 species of birds—from the great auk to the passenger pigeon to the Labrador duck—have disappeared. That's about 50 times the expected extinction rate. As the century unfolds, some scientists are predicting that extinction rates for all families of plants and animals will explode to between 1000 and 10,000 times the background levels.

"The evidence pointing towards a mass extinction is very clear and it's growing more compelling day by day," says Baker. "These are not just rare island species, birds that have been trembling on the edge of disaster for years. We're talking about birds that have been relatively common since time immemorial."

Dr. Mark Engstrom, the ROM's director of Research and curator of Mammalogy, lends his strong, though more cautious, endorsement to the theory. If we are not yet immersed in the sixth wave of extinction, he says, we are poised on the cusp. In the last 500 years, human activity has pushed 816 species of plants and animals to extinction in the wild; another 11,046 are on the World Conservation Union's waiting list. "Mankind has already precipitated a minor extinction event. . . . Whether it continues is entirely up to us. It does appear that we are picking up the destructive pace."

Determining exactly what that pace is, though, remains a problem. Many species are disappearing before they can be collected, documented, or described. Mostly, it's the small stuff, the beetles, the rare tropical epiphytes—plants that take their nutrients from the air—the orchids, the nematodes—a type of unsegmented worm. "There are just so few people working on these organisms," says Engstrom. There are far more insect species, for example, than the existing systemic entomologists could ever classify. The biggest gaps are in the invertebrate and plant fields.

Sizable gaps exist in our knowledge of even the big, heavily studied classes of animals—known in the collecting world as "charismatic megafauna." Many mammal species are known only from a single specimen, a location, and the sketchiest description of their habits. Based on the rate that new species are now being discovered and described, there are probably 500 more that have yet to be found. Engstrom has five previously unknown species of rodent in his lab, waiting to be described.

To date, taxonomists have identified some 1.75 million species of the maybe 10 to 30 million that co-exist with us on Earth. We've probably only catalogued 10 percent of the total number of species, "and that's a generous estimate," says Engstrom. "But it's also a flat-out guess. We just don't know."

Paleontologists, well versed in the analysis of vast historical trends and patterns, bring a valuable perspective to the possibility of mass extinction. "It's very difficult to say whether we are in the midst of an event as profound as the great waves of extinction seen in the fossil record," says Hans-Dieter Sues, who is also the ROM's curator of fossil vertebrates. "But if the damage continues to accelerate," he adds, "we may well approach a rate of species elimination rivalling those of the previous five mass extinctions." Large numbers of existing life forms could very well disappear, Sues says, "leaving the remnants struggling to rebuild a viable, working ecosystem." The process takes perhaps a few

The Tides of Change

Across the span of Earth's history, five distinct episodes of mass extinction have occurred, each one wiping out 70 to 95 percent of living species. Here are the highlights of each:

#1 **450 million years ago**

During the Ordovician extinction, more than 100 families of marine animals disappeared. Global cooling, widespread glaciation, and dropping sea levels (which exposed the rich continental shelves) were the probable causes.

#2 **350 million years ago**

During the Late Devonian period, as the first great forests spread across the earth, a mass die-back wiped out the reef-building corals, many of the brachiopods, trilobites, and all the jawless fish. While most terrestrial flora and fauna persevered, some 70 percent of the marine invertebrates failed to survive into the Carboniferous Age.

The "Ex" Files

These Chinese tiles dating to the second half of the 6th century AD depict creatures who played a role in Chinese folklore. Only 23 are known to exist in the world. Joey and Toby Tanenbaum recently donated 15 of the tiles to the ROM.

August 1998 The World Conservation Monitoring Centre and the World Conservation Union say 8750 species of trees—about one-tenth of those known to science—are at risk of extinction. Loss of habitat, poor logging practices, and the invasion of alien species are considered the major threats. Many species have been reduced to a single plant; unable to reseed themselves, they have been dubbed "the living dead."

August 1999 The president of the International Botanical Congress compiled and presented a seven-point plan to slow the extinction of plant species. World-wide, one in eight plants is threatened with extinction. In the United States, the ratio rises even higher to nearly one in three: some 29 percent of the country's trees, flowers, and ferns are deemed at risk.

October 1999 Unless immediate action is taken, extinction should claim some four percent of North America's freshwater species each decade. Animals at risk include half the 262 species of mussels, one-third of the 336 crayfish species, one-quarter of the 243 amphibian species, and one-fifth of the 1021 fish species. Threatened by dams, water diversions, and pollution, freshwater animals are dying out five times faster than terrestrial species.

October 1999 BirdLife International says 12 percent of the world's birds—some 1200 species—are threatened with extinction in the next 100 years. With habitat destruction listed as the chief problem, some three-quarters of the threatened birds live in tropical forests. The group is considering adding another 600 to 900 species to the growing list.

November 1999 Manatees and six rare migratory birds are added to the growing list of species to be protected under the Bonn Convention on the Conservation of Migratory Species of Wild Animals. Another 30, including dolphins, sturgeon, whale sharks, and seven petrel species, will be protected in other ways. Over the past 25 years, the number of birds migrating between Europe and Asia has declined by one percent per year, and could disappear entirely in 100 to 200 years.

April 2000 A University of Ottawa researcher says that global numbers of amphibians dropped 15 percent from 1960 to 1966, and continued to decline two percent a year through 1997. Extensive data on 936 populations of amphibians—including 157 species in 37 countries—were collected largely over the Internet. While some populations are experiencing periodic booms, overall the booms are not overcoming the declines.

September 2000 According to its 2000 "Red List," the World Conservation Union claims that the global extinction crisis is "as bad or worse than believed," with dramatic declines in the populations of many species. In just four years, since the release of the WCU's last list, the number of critically endangered mammals has jumped from 169 to 180, and critically endangered birds from 168 to 182. A total of 11,046 species of plants and animals are facing a high risk of extinction in the near future. To stem the losses, the union says we must commit between 10 and 100 times the current levels of financial resources and numbers of people actively working toward conservation.

November 2000 Long thought impossible, over-fishing has pushed a number of North America's saltwater fish populations to the edge of extinction. The American Fisheries Society lists 82 species and stocks, including a number of long-established commercial and recreational fisheries, "at risk of extinction." Among those threatened are the Atlantic halibut and cod, the West Coast ling cod and sea bass, and 10 species of wide-ranging sharks and sturgeon.

years, perhaps a million years. The fossil record only adds to the difficulties in calculating an exact extinction rate. The problem with reading the fossil record accurately, says Sues, is that it tends to compress time tightly together. Within its rocky pages, events that might have stretched over tens of thousands of years appear to unfold instantaneously.

Another snag in comparing current and historical extinction rates is the fossil record's incompleteness; many species have left no permanent vestige of their passing. "The vast majority of all the human beings that ever existed have disappeared into the ground without a trace," says Sues. "And *Homo sapiens* has a skeleton." Most of the soft-bodied animals and plants leave few fossil remains.

That's why it's so hard to estimate a "normal" background extinction rate. And when you don't know the number of species you started with, or what you are losing, it's difficult to calculate the current rates of extinction. "We need better baseline data," says Sues. "We have such a limited picture of the Earth's biodiversity. Science has just scratched the surface."

Over the last 20 years, biologists have been refining a sophisticated mathematical model of extinction. It's based on a classic theory of island biogeography proposed back in 1963 by two Harvard biologists, Robert MacArthur and Edward O. Wilson. The theory, since validated in extensive field studies, established a clear logarithmic relationship between the size of an island and the number of species that live there. Decrease the size of the island by just one-tenth and the original number of species will drop by 50 percent. It doesn't happen overnight. If a given habitat is suddenly destroyed, it will take about 50 years to lose half the species it is going to lose and a century to lose three-quarters of them.

A number of scientists have taken the principle of island biodiversity and applied the same mathematical formula to the tropical jungles, the "hot spots" of biodiversity that are home to vast numbers of the world's plants and animals. This works because the large tracts of jungle aren't environmental monoliths. In most cases, a single species doesn't inhabit, say, the entire Amazon basin; endemic species are restricted to smaller pockets or ridges—islands in a deceptively unbroken cover of forest.

"Many species are isolated one-offs," says Engstrom, "and only occur in one place." The Maya deer mouse, for example, lives only on one isolated mountaintop in western Guatamala. Once you cut down, plow under, or pave over that small patch of dense, mossy forest, that species is gone forever.

Within 50 years, several studies show, if we continue cutting at the current rate, only five percent of tropical forests will remain—all in protected areas. Extinction rates, based on mathematical modelling, will be three or four orders of magnitude higher than those normally thought to prevail between the great waves of extinction. Wilson, one of the pioneers in recognizing the extent of current extinctions, estimates 30,000 extinctions a year—that's 600 a week—or approximately one every 17 minutes. Almost all of the victims are nameless; they've never been collected or catalogued. Their passing goes unremarked and largely unmourned.

Until now, says Engstrom, extinction has claimed the most susceptible species. But clear-cutting and other macro-environmental disruptions caused by humans are stripping away hundreds, maybe thousands, of undocumented species, including some that could have offered valuable service. Many of the newest cancer-fighting drugs were derived from tropical plants: the fruit of the African sausage tree, the rosy Madagascar periwinkle, or the bark of the Pacific yew. Tomorrow, we might bulldoze into extinction a flower that would have provided the next breakthrough cure, or the butterfly that pollinates that bloom, or

#3 250 million years ago

At the end of the Permian period, some 85 to 95 percent of marine life forms and 70 percent of all terrestrial species vanished during what's been called "the Mother of all Mass Extinctions." For a time, fungal species ruled the world. Numerous theories have been suggested to explain the cataclysm. Perhaps another ice age lowered sea levels (again) . . . or tectonic shifts destroyed much of the continental shelf . . . or there was a major shift in the balance of atmospheric gases . . . or global warming dried up tropical seas . . . or perhaps huge volcanic eruptions in present-day Siberia wrapped the planet in a shroud of ash sending global temperatures plummeting.

#4 200 million years ago

At the end of the Triassic period, most land and marine invertebrates as well as plant species were wiped out—the second most devastating loss in Earth's history. The dinosaurs, however, survived and flourished. Theories about the cause have ranged from climatic change to massive volcanic eruptions, but most recently have focused on a huge asteroid impact.

the bush on which the larvae of that butterfly feed, or . . . to paraphrase folk singer Joni Mitchell, we won't know what we've got till it's gone.

Despite all the persuasive modelling, the sixth wave is still a theory, and not everybody agrees with it. "It's been extremely difficult to get good estimates of extinction rates," says Laura Jones, director of environmental affairs for The Fraser Institute, "especially when we aren't even sure how many different species there are." As spokesperson for the Vancouver-based free-market public policy think tank, Jones claims that "pure guesswork" underlies many of the estimates of species loss that many people now treat as scientific fact.

Some people still claim the evidence that we are approaching a mass extinction event is weak or equivocal or based on creative modelling, says the ROM's Allan Baker. But that's all rubbish.

"There's no doubt we have some endangered species we should be concerned about," says Jones. But she doesn't believe we are facing a crisis situation . . . at least not in Canada. Canadians might be surprised and relieved to learn that "the last mammal extinction in Canada wasn't last week, or last year," says Jones. "It happened 81 years ago, when over-hunting wiped out the population of woodland caribou in the Queen Charlotte Islands."

"It's good to be concerned," she says, "but we have to temper our concern with some serious scientific questions." Unless and until researchers are able to eliminate a lot of the guesswork that Jones believes underlies extinction modelling, she won't be convinced that we are part of, or responsible for, a sixth great wave of extinction.

The ROM's Allan Baker isn't buying this argument. "Some people still claim the evidence is weak or equivocal or based on creative modelling," he says, "but that's all rubbish."

Engstrom agrees. Because Canada has relatively low species diversity and one of the lowest human population densities in the world, he says, extinction isn't yet having the same impact here as it is in the tropics. But as you travel southward, both human population densities and species diversity increase exponentially—and they are on a collision course.

Already, satellite photography is providing accurate data on changing land-use patterns and deforestation rates. Field biologists are documenting the effects of the fragmented forest on species diversity. And the Internet, which is proving to be the great facilitator in this exercise, allows scientists around the globe to compile population trends quickly.

Anyone wanting to study trends in butterfly populations or hedgehogs or dung beetles can log into the online collections of the world's museums to construct a global perspective on what's happening. Researchers are continuing to computerize years of census data, breeding statistics, and distribution records. Once that's done, says Baker, we can begin to understand better just what's going on. According to the preliminary results, it looks as if certain populations are disappearing, ranges appear to be contracting northwards, and species diversity seems to be decreasing. "There

are fluctuations," says Baker, "but, generally, it sure looks like the numbers are going down."

In this depressing scenario, the primary culprit is humanity; the primary mechanism of extinction is habitat fragmentation, degradation, and loss. Over-hunting, over-fishing, and the introduction of alien species into new environments also play roles in the extinction process. Sues predicts that future observers should readily be able to plot certain of humankind's more dramatic modifications to the Earth's surface—the spread of deserts, for example, or the build-up of contaminated sediments in lakes and estuaries, the shrinking of tropical forests, and so on. Our fossil footprint should prove indelible.

We know that critical ecosystems are disappearing at a rate unprecedented in human history, says Sues. "Every year we clear an area of tropical rainforest about the size of Switzerland. You only have to compare the Amazon basin with what existed 50, 20, even 10 years ago to see the tremendous changes we are imposing on the planet."

Consequently, there will also likely be a sudden and discernible drop-off in the number of large mammals represented in the future fossil record. "We have done a pretty good job at wiping out most of these," says Sues. As *Homo sapiens* swarmed out of Africa and across the globe—up through Europe and Asia, across the Pacific, and down into the Americas—our ancestors quickly exterminated many of the world's large mammals. We consigned the woolly mammoth and the mastodon, the giant kangaroo, the marsupial lion, the elephant bird, and hundreds more to the paleontologist's vault.

The populations of so many of the survivors—the great primates, say, or various of the whales—are so small and vulnerable that their survival is questionable. To anyone who looks back over the Holocene Epoch, encompassing the last 10,000 years, "it will appear to have been a fairly active time," Sues says ruefully.

Even more disturbing is Engstrom's warning. "These extinctions might be an omen," he says, "or rather, a bellwether tolling our own imminent fate." As humans, we are not only the perpetrator of a massive ecological crime; if we continue unchecked, we are almost certain to be one of our own victims. *Homo sapiens* is a relatively new species. We have only been blundering about for some 200,000 years, so far. "The lifespan of a typical mammalian species is one or two million years," says Engstrom. "Unfortunately, it looks like we are going to fall well under the average."

And after we are gone? The enduring legacy of *Homo sapiens'* passage on the planet is likely to be a rather thin layer in the geological strata, dominated by coke bottles and aluminum beer cans, and spiked with radioactive isotopes and heavy metal pollutants.

Can we still escape this fate?

Paleontologists tend to be sanguine about these things, Baker laughs. After all, the previous waves of extinction provided great new opportunities for the next generation. The die-off of the dinosaurs gave us mammals our big break. But all the previous mass extinctions were caused by cataclysmic events: massive volcanic explosions, meteors slamming into the planet, great shifts in global warming or freezing. "The difference this time is that it's man-made," says Baker, "and it's avoidable."

If we're to stem the sixth wave of extinction, the role of museums will be critical. As Sues sees it, the job is two-fold: document our threatened biodiversity and educate people about it. Museum curators are already clambering through rain forests, rappelling into caves, and trekking across

#5 65 million years ago

At the end of the Cretaceous period, the great Age of the Dinosaurs came to a sudden and dramatic end, ushering in the new Age of Mammals. During the crash, an estimated 85 percent of the world's species were eliminated; many kinds of plants, marine reptiles, bivalves, and plankton joined the dinosaurs in the fossil record. Today, a lively debate swirls around the cause of "the Great Dying." While many believe that the after-effects from Earth's collision with a meteor wiped out the giant lizards, others argue that explosive volcanic eruptions disrupted climate patterns and fatally altered ocean chemistry.

#6 Today? Tomorrow?

Many scientists warn that some 50 to 70 percent of the world's existing species, most of which we have yet to document or describe, will be driven into extinction by the end of the 21st century. This time, the responsible agent, *Homo sapiens,* is one of those threatened species. The proposed mechanisms of extinction include deforestation and habitat destruction, global warming, intensive agriculture and pesticide use, over-hunting and over-fishing, and all the other stresses that human over-population exacts on the environment.

the tundra in order to collect, document, and record the natural world. And, as Sues points out, nobody else is doing this kind of work.

Government funding for field research is drying up. The universities have largely abandoned natural history and whole-organism biology, concentrating instead on molecular biology and the other lab-based disciplines. A student of zoology or botany can graduate without ever working a day in the wild, without collecting, handling, or even observing a single live specimen in the field.

These extinctions might be an omen, or rather, a bellwether tolling our own imminent fate. As humans, we are not only the perpetrator of a massive ecological crime; if we continue unchecked, we are almost certain to be one of our own victims.

Today, museums are the primary repositories for the kind of detailed information required to understand and plot the trends in speciation and extinction. "Museums are the primary engine for specimen collection and identification," says Engstrom. "We have the data on a species' range and distribution, what habitats it prefers, what communities it thrives in, what other species co-exist with it. All this information resides in the research collections of museums. We are the library of biodiversity."

This library is crucial to illustrating conclusively the dangerous shifts occurring in the biological balance. Politicians tend to be both skeptical and reactive; they must be convinced, then pushed to work for change. The raw data assembled so painstakingly by museum staff is the information that scientific unions, eco-activists, and international agencies can use to lobby for environmental action. As well, a growing network of bird-watchers and other amateur naturalists, who are monitoring individual species or trends in ecosystem health, are supplementing the work of museums.

Curators themselves cannot be passive observers of the planet's environmental deterioration. "This is NOT a salvage operation," Engstrom stresses. Museums are not simply counting the casualties, conducting a death watch on a dying planet. Collecting, classifying, and documenting wildlife aren't enough, agrees Baker. "More scientists have to get involved in protecting it."

In an effort to raise awareness and protect species, curators have rolled up their sleeves and become involved in the day-to-day struggle for conservation. Baker works as part of an international team that coordinates and promotes environmental protection programs for migratory birds up and down the flyway, from Tierra del Fuego at the tip of South America to the High Arctic. "It might not be the traditional work of the research scientist," says Baker, "but it's the most rewarding thing I've ever done."

It may sound clichéd, but it is no less true: ultimately, the future lies with our children; museums must educate a new, more effective generation of planetary guardians. "The role of the life science staff," says Sues, "is to conduct a very strong advocacy program for school children and our other visitors." Fortunately, the public is receptive to the message. That's good news if we are to have any hope of stemming what is looking more and more like the sixth wave. ■

CULTURE, ART AND DESIGN

What Lies Beneath

X-ray technology is a key diagnostic tool in art conservation — and may even uncover an artifact's surprising hidden history.

RADIOGRAPHY—the use of X-rays to photograph the interior of objects—was invented in 1895. Right from the beginning, people were interested in discovering what lay inside objects of all types. It was only one year after the technology's invention that X-rays were first aimed at an object of art. Since then, conservators have turned frequently to X-rays not only to determine a work's authenticity but to plan its restoration. Occasionally, X-ray photographs reveal other secrets obscured by time, which add to an object's mystique.

Through images taken by the ROM's two X-ray machines, housed inside a lead-lined room, conservators can peer into an object's interior to better understand its underlying construction and materials, which can be essential in deciding how best to approach a method of repairs. An artifact coated in centuries-old layers of paint, for example, may have a fragility—internal cracks or other damage—that can be detected only in this way.

In the case of furniture, X-rays reveal such things as whether nails have cracked the wood or are rusting, telling the conservator that further work must be approached with extra caution. Poorly done previous repairs, such as the inappropriate addition of wood pieces or fillers, may lead to damage when new conservation work is attempted, and in some cases the conservator may decide to leave the object as it is.

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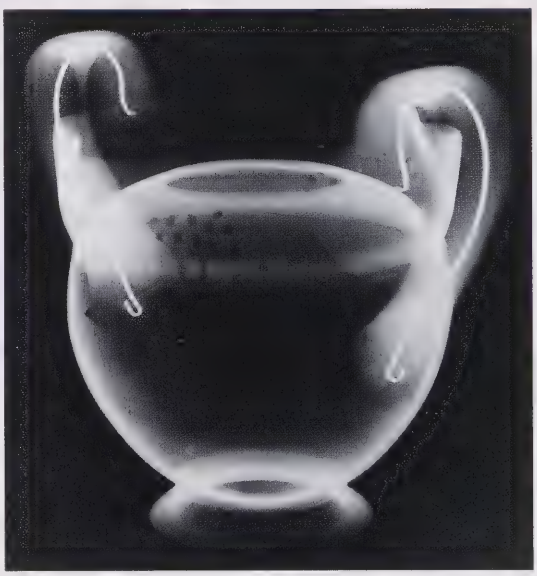

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Top left:The old restoration handles can be seen on this Etruscan pot prior to recent ROM conservation work. Alongside is one of the pot's original handles.

Bottom left: This X-ray photograph clearly shows that wires were used to repair the Etruscan pot, and that the handles pictured above were therefore not the originals.

DOUGLAS CONVERSE

For artifacts with an opaque or impermeable surface coating, such as lacquer or gilding, X-rays show what materials lie beneath. Understanding the structure of a particular work—whether it is solid or constructed of several pieces—may be vital to maintaining the object's original appearance once it has undergone restoration. Several of the bodhisattvas in the Bishop White Gallery have been X-rayed to determine how the appendages are attached to the torso.

X-ray information is helpful not only for conservators; it also assists the Museum's curatorial staff to clarify when, where, and how an object was made. In one instance, staff suspected that the head on one of the bodhisattvas was not original but that centuries of painting had obscured past repairs. An X-ray showed that the join between the head and the body was a perfect fit, proving that the head was, indeed, the original.

Other objects in the Museum's collections demand limited handling, and X-rays provide the perfect non-invasive method of research. Ancient

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THE MAGAZINE OF THE ROYAL ONTARIO MUSEUM

968.298.3

Top left: The portrait of Charlotte Berczy, painted in 1785 by Charlotte's husband, William Berczy.
Bottom left: An X-ray photograph of the portrait shows how the hair, eyebrows, and collar differ from those in the final picture.

Egyptian mummies, for example, are often X-rayed to view what is under their delicate wrappings without having to remove them.

One of the ROM's X-ray machines—which uses a process essentially no different than the one used by a dentist—is dedicated to photographing three-dimensional artifacts and specimens. Through experience, ROM staff have found that different materials require exposure to the X-ray at varying intensities and for different lengths of time. Paintings need only a short exposure, but denser materials, such as metals or bone, require longer exposure times and higher kV ratings.

The X-ray film, like any photographic negative, is developed in a darkroom. It takes a trained eye to evaluate the image produced by a three-dimensional object, as all elements overlap one another on a single plane. An X-ray of a clay pot, for example, will expose any cracks on the front, back, and all the way through the walls. The trick is to determine on which surface the cracks appear.

X-ray technology is particularly helpful in restoring objects that have received poor or inappropriate repairs in the past. One of the most interesting cases undertaken by ROM conservator Ewa Dziadowiec was that of an Etruscan ceramic pot now on display in the Museum's Etruscan Gallery.

One day, an odd handle was found mixed in with some other artifacts in storage. Nobody knew where it came from. Ewa and John Hayes, then curator in the Greek and Roman Department, wondered if the handle belonged to one of the pots in the ROM's collection.

They carefully studied a few and found one, although very much intact, whose handles were slightly different in shape than the others. The pot looked pristine on the outside—it must have been expertly repaired—but an X-ray photograph revealed that neither of the handles was original. The evidence: tell-tale wires supporting both handles were exposed in the X-ray. The old restoration handles were removed; then Ewa re-attached the original handle and had another replacement handle created to match it.

The ROM's second X-ray machine is a table unit, used mainly for flat objects. This unit is often used to check paintings for old repairs, such as torn canvas or retouching.

A portrait of Charlotte Berczy painted in 1785 was undergoing some restoration work in 1991, in preparation for a large retrospective at the National Gallery in Ottawa, when a surprise discovery was made.

An X-ray photograph revealed that some aspects of this original work from the ROM's prized Canadiana collection had been altered by the artist: the eyebrows were lightened, the neckerchief changed to a ruffled collar, and the hair re-arranged to fall over the woman's shoulder to better frame her face.

Although no one is certain why the changes were made, one may guess that they were requested by the sitter to make the portrait more flattering. Or, perhaps they were the second thoughts of the artist himself, William Berczy—Charlotte's husband.

Today, recent advances in computer technology allow X-ray images to be scanned and stored electronically or transmitted via e-mail to other conservators for reference, study, or educational purposes.

Now over a century old, X-ray photography is no longer the latest in modern scientific technology, but the machines used at the ROM remain essential in aiding conservation staff in their work.

Newer exploratory technology—such as the CT-scans that recreated an image of the ROM mummy Djed-maatesankh—are far too costly to replace the simple-to-use X-ray machines, which continue to help the Museum's conservators investigate the ancient and the not-so-ancient mysteries behind the artifacts in the ROM's collections.

Douglas Converse has a keen interest in conservation and worked with ROM conservator Marianne Webb on her book Lacquer: Technology and Conservation.

CULTURE, ART AND DESIGN | LIFE ON EARTH

Canoes and Cornices

The History of the Guild Inn

Carole Lidgold
(Brookridge, Paper: $24.95)

The Scarborough Bluffs extend from Toronto's Beaches east nearly to Highland Creek and are then echoed from Rouge Beach east again toward Frenchman's Bay. The fabled Guild Inn is situated at the pinnacle of them, where it commands a secluded woodland site. Built as the country chateau of General Harold Child Bickford in 1914, the inn was purchased in 1932 by Spencer and Rosa Clark, whose vision it was to create a "guild of all arts" based on the medieval craft guilds model. General Bickford's stable for polo ponies became the central studio, and through the 1930s the retreat became a haven for weavers, sculptors, and ceramicists. Water was sourced from what David Boyle's 1896 local history had termed "healing wells" to the immediate west. Idyllic Canadian nature scenes were intricately hand-carved into the headboards of the inn's beds.

By 1940, many of the artists had signed for military service, their inventory of copper was shipped to a munitions plant in Ajax, Ontario, and the Government of Canada appropriated the inn as a recuperative hospital for veterans. The Clarks moved to their city home at 1 Dale Avenue in Rosedale.

FEATURE REVIEW

The Canoe: An Illustrated History

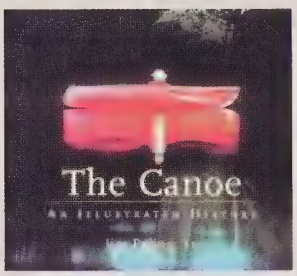
Jim Poling, Sr.
(Key Porter, Cloth: $29.95)

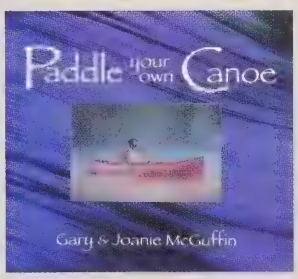
Paddle Your Own Canoe

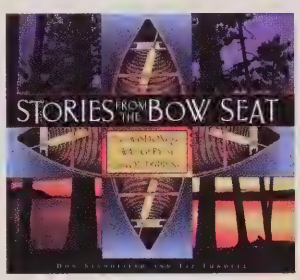
Gary and Joan McGuffin
(Boston Mills Press, Cloth $39.95)

Stories from the Bow Seat: The Wisdom and Waggery of Canoe Tripping

Don Standfield and Liz Lundell
(Boston Mills Press, Cloth: $49.95)







The great Canadian freight canoe, the railway and tractor-trailer of the fur trade, has become an enduring symbol of Canadian industry, commerce, and culture. In 1971, master canoe builder César Newashish created a replica. Built to the specifications of antecedents, as gleaned from tradition and the art record, it is situated in the ROM, above the Canadian Heritage Floor. Its aerial perch suggests the ancient Canadian folk legend *La Chasse Galerie,* in which haunted voyageurs navigate the night sky. The ROM's celebrated collection of Canadian historical prints and watercolours contains numerous depictions of such craft, including *Tracking the Rapids,* by Frances Anne Hopkins, featured in the new edition of the Museum's souvenir book *Worlds to Explore* (ROM, 2001).

Historically an inspired synthesis of muscle, wood, and water, the canoe and canoeing are vividly explored in three complementary volumes. Poling's illustrated history is a pictorial odyssey, a skilful mix of archival prints and evocative nature photography. The McGuffins' is the ultimate how-to book of canoeing. Clear and detailed colour photographs illustrate adept manoeuvres and maximum efficiency in every possible situation. After a long day of paddling, try reading Standfield and Lundell's *Stories from the Bow Seat,* by lantern light. From wild adventure to the mystical, it ultimately compares canoeing to the native vision quest, "a time for regeneration, a cleansing of the body and mind, and the realization of nature's powerful magic."

BRIAN BOYLE, ROM

COMPILED AND REVIEWED BY GLEN ELLIS

From the end of the war until their advanced years, the Clarks continued for some four decades to soldier heroically on behalf of the arts, buying and commissioning works from new and established artists, A. J. Casson and Sorel Etrog among them. Distressed by the slated demolition of much of downtown Toronto's heritage architecture, they rescued from oblivion the most significant elements of more than 60 of the city's edifices. Today, Corinthian and Ionic columns, arches, capitals, balustrades, facades, and bas reliefs from 19th- and early 20th-century Toronto—even the carved limestone panels that once graced the main entrance to the 1938 *Globe and Mail* building—stand in the inn's picturesque gardens, mute testimony to the Clarks' noble and inspired vision.

Little Buffalo River

Frances Beaulieu
(McGilligan Books, Paper: $12.95)

THE ROM'S FRANCES BEAULIEU mines her experience of growing up Métis in the Northwest Territories, then cuts and polishes it into an array of jewels. Her style is tough and evocative, hard-edged and poetic, her world the border between dream and nightmare. Through the darkness, her spirit walks on light. Irrepressible. A tale of persistence and validation. A major new talent. Literary awards jurists take note.

Who Killed the Great Auk?

Jeremy Gaskell
(Oxford, Cloth: $40)

NORTH ATLANTIC SEAFARERS piloting near the crags of coastal isles were, historically, alerted by the sudden clamour and flight of the auk, a natural beacon in the mist. Human tooth-and-claw exploitation of the auk for its meat, feathers, and eggs, and the invasion and destruction of its habitats, made it a melancholy icon of extinction and a catalyst for Britain's *Act for the Preservation of Seabirds*, of 1869.

Gaskell's sad tale of the auk is disturbing and ultimately cautionary, the question posed by its title not a mystery.

Glen Ellis is head of Publications, Royal Ontario Museum.

ROM BOOKS

A new feature, ROM Books showcases the Museum's newest publications and co-publications.

The ROM Field Guide to Birds of Ontario

Janice M. Hughes
(ROM, M&S,
Deluxe Paper: $26.99)

ONTARIO HAS A LARGER territory and population than most countries of the world. It's high time, then, that there was a beautiful and authoritative field guide series devoted solely to the province. Royal Ontario Museum Publications and McClelland & Stewart have collaborated to produce this, the first title in a field-guide series dedicated to the natural world of Ontarians.

Ontario is blessed with a rich birding habitat and a great diversity of species. Many birds associated with more southerly latitudes are visitors here, including the elegant purple-and-indigo Little Blue Heron. A rare to occasional visitor, it ranges in Ontario from Pelee Island to Ottawa and as far north as Thunder Bay.

The definitive guide to Ontario birds, the ROM guide includes all of the species observed and observable in the province. It also includes hundreds of full-colour photographs from many of Ontario's most celebrated nature photographers. It's even printed in Ontario.

Owls, hawks, and eagles, herons, ducks, and songbirds—whatever your area of avian interest—this is the book.

Dr. Janice M. Hughes is a departmental associate with the Royal Ontario Museum's Centre for Biodiversity and Conservation Biology.

CULTURE, ART AND DESIGN

Rare Coffee Pot Causes a Stir

Loyalist heirlooms with a known Canadian provenance are exceedingly rare. Recently, a silver coffee pot with an impressive pedigree was acquired by the ROM.

Dear ROM Answers,

I am curious to know whether the Royal Ontario Museum owns any items that came down from the Loyalists. Do many pieces survive from that migration?

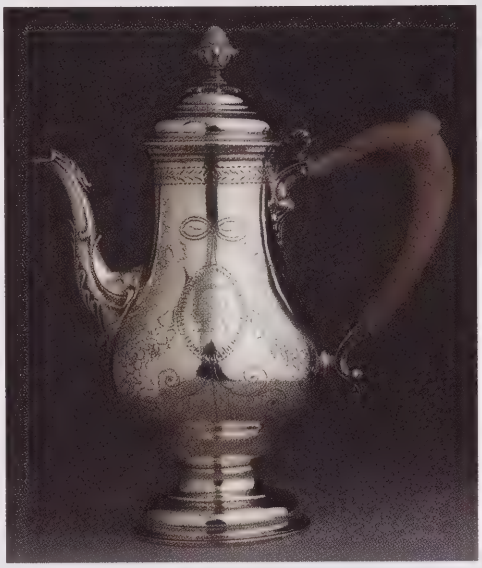
S. M., Sudbury, Ontario

Dear Reader,

Loyalist heirlooms with a verifiable Canadian provenance are extremely rare. It must be remembered that Loyalists were political refugees forcibly expelled from the American Thirteen Colonies under war-time conditions. As a result, most left only with whatever they could carry. Anything of value was usually stolen or confiscated by zealous patriots. But even the possessions left behind by most Loyalists were modest enough. The overwhelming majority who emigrated to Canada were ordinary folk—tradesmen, farmers, soldiers. There were a few landed gentry and wealthy merchants among them, but as a whole, the Loyalist upper echelons preferred to return to the motherland.

All too often, significant surviving artifacts brought to Canada by Loyalists became disassociated from their history—a situation exacerbated by a long-standing antipathy among Canadians to collecting early American decorative arts. Museums and private collectors share equally in the sentiment, which persists to this day. Consequently, when Loyalist pieces surface on the Canadian market they almost invariably end up south of the border.

A silver coffee pot recently acquired by the Royal Ontario Museum was rescued from just such a fate. It came to the ROM through the intervention of the Canadian Cultural Property Export Review Board with additional financial assistance from the Jeanne Timmins Costello Trust of Montreal.



BRIAN BOYLE, ROM / 998.55.1

ROSS FOX

The coffee pot's maker is Samuel Tingley of New York City. His marks, a script "ST" and "N.York" in shaped rectangles, are struck on the underside of the piece. The body is double-bellied (also called an inverted pear-shape) with an attenuated, incurved neck. The S-curved spout is ornamented with acanthus leaves.

Many silver coffee pots were made in the years immediately preceding the American Revolution. The popularity of coffee escalated after passage of the *Townshend Acts* in 1767, which imposed a tax on tea. This tax, of course, was a key factor in precipitating armed insurrection against England. Stylistically, the Tingley pot dates to this period, the height of the Rococo in America, around 1765–1775.

In the literature, it is noted that handle mounts and a spout almost identical to those on the ROM's Tingley pot are also found on a coffee pot by Meyer Meyers, also of New York. Of the two silversmiths, Meyers was the more accomplished and successful. Could it be that he supplied these components to Tingley? Chasing, or tooling, after removal from a mould would easily account for any minor differences. Meyers was one of the rare colonial silversmiths who kept up on the latest English fashion, and it's possible that Tingley looked to Meyers for his general design as well, though the shape of the Tingley pot lacks the

graceful curves of a Meyers piece.

Too little is known about Tingley's production, however, to make a safe assessment of possible sources. In fact, not a great deal is known about Tingley at all. The only records of his working as a silversmith in New York are from 1762 and 1767. It is presumed that by the 1790s he was living in Philadelphia—a Samuel Tingley is listed as goldsmith in that city in 1796.

We do know, however, that Tingley was one of a few colonial silversmiths to make cast candlesticks. If he was adept at casting such large objects, certainly he could have cast a coffee pot spout. It is premature, then, to attempt a definition of any exchange between the two artisans. Ultimately, colonial silversmiths imitated English models.

The key difference was that English examples tended to be more effusively embellished. The engraved decoration on the Tingley piece has an incongruous aspect, given the pot's Rococo style. Neoclassical both in design and technique, the engraving depicts armorials on shields within beribboned, oval reserves, linked by floral swags. Ancillary motifs include a feather-like band around the upper neck of the pot and summary garland-like bands around the domed lid and foot.

The decoration is bright-cut, an engraving technique first introduced into England in the late 18th century. It employs small gouges which, when worked against plain surfaces, create a faceted effect. This kind of engraving was most popular in the United States during the 1790s, although it did occur in the preceding decade—still almost a decade later than the Tingley coffee pot was likely made. The engraving on the Tingley pot must, therefore, post-date the pot itself.

Its rendering is somewhat infelicitous, a problem only compounded by further elaboration later in the 19th century. (The wooden handle is also a later, unhappy replacement. The original would have had a more elegant, looped shape.) However ungainly the workmanship, the engraving is a significant feature: it allows us to confirm the coffee pot's provenance. One side of the pot is engraved with a crest consisting of a demi-lion facing left and holding a five-pointed star. On the other side, the engraved arms consist of an upper band with three pointed stars, and in the field below, a lion rampant facing left. These are the crest and arms of Inglis of Cramond in Lanarkshire, Scotland. Evidently, the original owner of our coffee pot was the Loyalist Bishop Charles Inglis (1734–1816), whose grandfather originated from Lanarkshire, although Inglis, himself, was born in Ireland.

Charles Inglis was appointed a curate to Holy Trinity Church in New York City in 1766. The clerical assignment positioned him for social advancement, and in 1773, he married Margaret Crooke of Ulster County. It was his second marriage and one that brought him a fortune. In 1777, he was made rector of the church.

His new wealth is reflected in a

WE'D LIKE TO HEAR FROM YOU

If you own furniture, silver, glass, metalwork, ceramics, textiles, or small decorative objects that may have an interesting past and have aroused your curiosity, this column is for you. Send a clear colour photograph (or 35-mm colour slide) of the object against a simple background, providing dimensions, a description, any markings, or any known details of its history to: ROM Answers, c/o *Rotunda* Magazine, Royal Ontario Museum, 100 Queen's Park, Toronto, Ontario M5S 2C6. Be sure to enclose a stamped, self-addressed envelope large enough to include any photos that must be returned to you.

Neither *Rotunda* nor the author nor any other person who may be consulted assumes any legal responsibility for these opinions or their ramifications. No financial appraisals will be offered.

Letters will be acknowledged as staff time permits.

statement of income submitted by Inglis to British authorities for the five years prior to 1783, which gives his average annual income as £817, a considerable sum. Most likely the coffee pot was purchased subsequent to this marriage and before the outbreak of revolutionary insurrection in 1775.

An ardent Tory, Inglis wrote pro-royalist pamphlets. Needless to say, he was *persona non grata* with the patriots, and when American troops temporarily occupied New York City in 1775, Inglis's house was looted. Four years later, the New York Legislature declared him guilty of high treason, making his property liable to confiscation.

Then, in 1783, under the protection of the newly signed Treaty of Paris, Inglis and his family joined 30,000 other Loyalist refugees who were evacuated from New York City and put on boats sailing for Nova Scotia (and New Brunswick). After depositing a few possessions and servants at Annapolis Royal, the Inglis family continued on to England. It was probably during this period that the Inglis armorial bearings were added to the Tingley coffee pot.

At a ceremony in London, England, in 1787, Inglis was consecrated Bishop of Nova Scotia and its Dependencies. Immediately afterwards, he returned to settle permanently in Halifax. In effect, Inglis was the first colonial bishop of the Church of England. His stature in the pioneer church has merited him the title "father of Anglicanism" in Atlantic Canada. Among his achievements was the founding of King's College, Halifax, in 1788–89, established for the training of a local clergy.

On the basis of stylistic and armorial clues, we now know that the coffee pot made by Samuel Tingley has an intimate connection with this illustrious Loyalist who chose Canada as his home.

Ross Fox is associate curator in the Department of Western Art and Culture, where he specializes in Canadian decorative arts.

COMING IN THE WINTER 2001 ISSUE

ROTUNDA

Pufferfish and the Genome Project

Francesco Santini looks at the ways systematic biology intersects with genetics

Centennial Campaign

Ontario's schoolchildren raised dollars for a dinosaur.

ROM ARCHIVES

JULIA MATTHEWS

In 1967, to mark Canada's 100th anniversary, the schoolchildren of Ontario raised $1500 for a Protoceratops skeleton for the ROM. Purchased from the American Museum of Natural History, the dinosaur skeleton was one of many specimens collected by the AMNH in Mongolia in 1922. These press shots from a series by Leigh Warren, documenting the fundraising campaign, are among my favourites in the ROM Archives' collection.

Unfortunately, the only names we know are "Fido," the African mountain monitor lizard—the campaign's poster animal—seen in the glass case (at left) and Tom Russell, 13 (at right), "who helped spearhead the campaign . . . he is keen on dinosaurs and spends considerable time studying." We'd like to hear from you, Tom.

The Protoceratops was displayed from 1967 to 1974. Both it and Fido remain greatly valued specimens in our collections.

Julia Matthews has been head of the ROM's Library and Archives since 1983. She has a special interest in museology.

If you remember an occasion at the ROM or an exhibition that has stayed with you across the years, send us your reminiscences at info@rom.on.ca.

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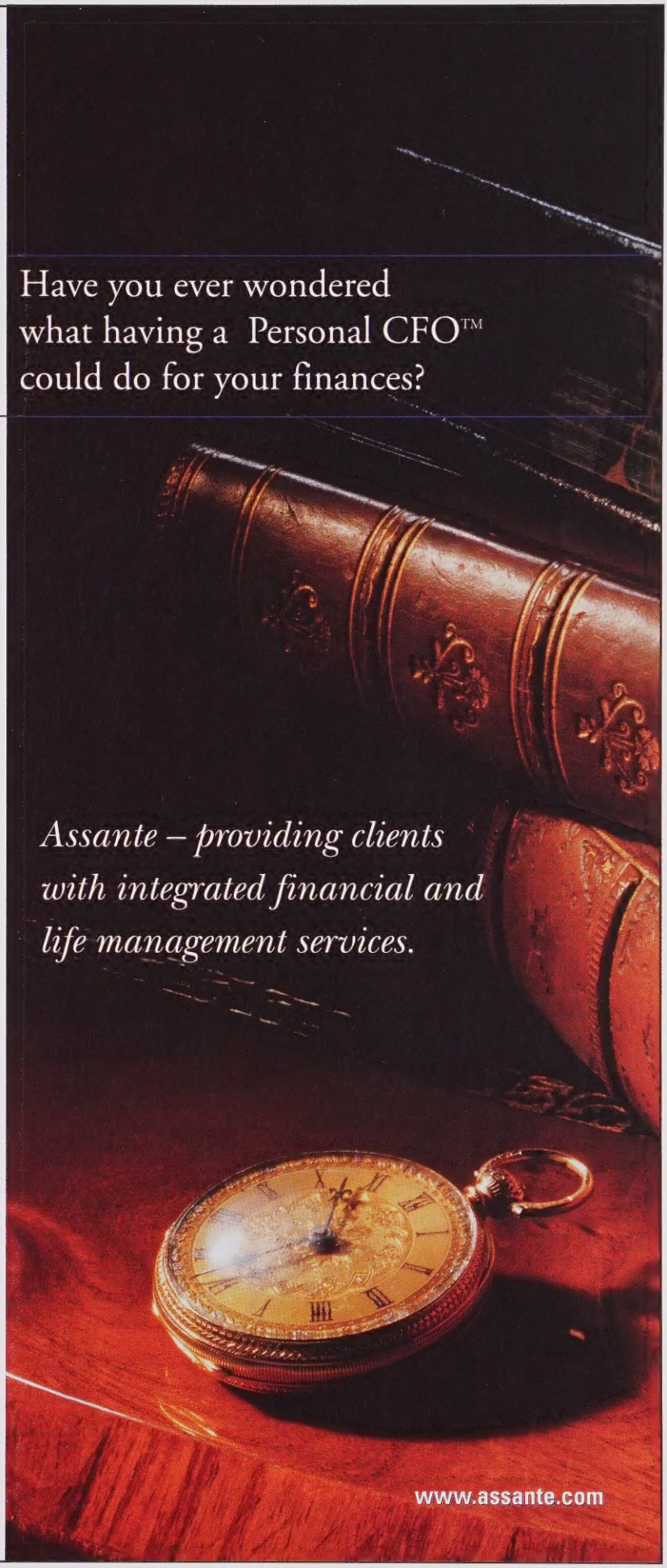

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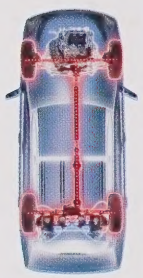
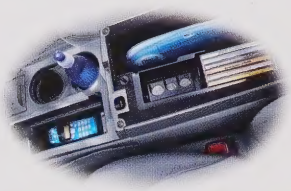


The Versatrak all-wheel-drive system automatically directs power to the wheels with the most grip.

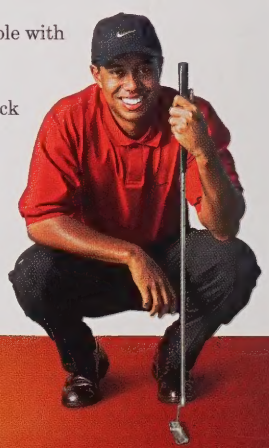
IS IT AN SUV? The all-new 2002 Buick Rendezvous combines the best of an SUV, a minivan and a luxury sedan into one incredibly versatile vehicle. With available Versatrak AWD, the Rendezvous automatically switches between front- and all-wheel drive to match road conditions. Its sturdy trailering package lets you tow up to 1588 kilograms,* while the interior offers a cavernous 2919 litres of storage. So you can go almost anywhere with almost anything. **IS IT A MINIVAN?** The Rendezvous can instantly adapt to a change in plans. The seats can easily be reconfigured to comfortably accommodate up to seven adults or to provide plenty of cargo space. Better yet, kids can even listen to their own music with the optional rear-seat audio system. Just the thing to pacify junior back-seat drivers.

Flip-and-fold seating combinations provide seating for seven adults or 2919 litres of cargo space.



Lockable centre console has room for a laptop, CDs and a cell phone.

IS IT A LUXURY SEDAN? The Rendezvous is still very much a Buick, with four-wheel independent suspension, a quiet ride and a powerful V6 engine. There's also a lockable centre console with auxiliary power outlets and space to securely store a laptop. The all-new 2002 Buick Rendezvous. With three vehicles in one, you'll never have to decide which car to take.



For more information, visit www.rendezvous.gmcanada.com or call 1-800-GM-DRIVE.

BUICK RENDEZVOUS

*Requires V92 Trailer Towing Package, capacity applies to no more than two people. Without V92, maximum trailering capacity is 907 kg.